DEPARTMENT OF THE INTERIOR.

BULLETIN

OF

THE UNITED STATES

GEOLOGICAL AND GEOGRAPHICAL SURVEY

OF

THE TERRITORIES.

F. V. HAYDEN,

U. S. GEOLOGIST-IN-CHARGE.

1874 AND 1875.

VOLUME I.

WASHINGTON:
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1875.

PREFATORY NOTE.

The Bulletin of the Survey was commenced in 1874 for the purpose of giving to the world, more rapidly than through the Annual Reports, the vast amount of new material which was constantly accumulating under the auspices of the Survey, and, in most instances, demanding prompt publication. When the first and second numbers were printed, it was not expected that it would continue long, or be issued with any regularity, hence the paging is not consecutive; but its success was so great that it commenced the year 1875 as a regular serial, and it will be seen that six numbers have been issued of about five hundred closely-printed octavo pages, with twenty-six pages of maps, sections, and other illustrations, with table of contents and full index. It is suggested that the entire eight numbers for 1874 and 1875 be bound in one volume as vol. I; and the table of contents and index have been prepared with that idea in view. During the year 1876 the Bulletin will be continued, the paging will be consecutive, and the illustrations numbered in their order so far as it is possible to do so.

Most of the articles in the Bulletin will not be reprinted, especially the more technical ones; but those of a popular character will appear again in the Annual Reports, usually much enlarged and improved.

It is to be hoped that the numbers already issued and distributed, both in this and foreign countries, have been preserved, inasmuch as several of them are already out of print and will not be re-issued.

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DEPARTMENT OF THE INTERIOR.

BULLETIN

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UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

No. I.

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BULLETIN

OF THE

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, NO. 1.

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JAMES STEVENSON .... *Quartermaster and Chief Executive Officer.*
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WILLIAM H. HOLMES .... *Artist and Assistant Geologist.*
CYRUS THOMAS .... *Entomologist and Agricultural Statistician.*
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*J. H. BATTY .... *Zoologist.*

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E. T. LUCE, S. H. NEALY, W. S. HOLMAN, SEWARD COLE, C. T. NOONAN, F. H. JACKSON, S. C. JONES.

Colaborators of the Survey.

†Prof. Joseph Leidy .... *University of Pennsylvania, Fossil Vertebrata.*
†Prof. E. D. Cope .... *Philadelphia, Pa., Paleontologist of the Survey, Fossil Vertebrata.*
†Prof. Leo Lesquereux .... *Columbus, Ohio, Paleontologist of the Survey, Fossil Flora.*
Prof. J. S. Newberry .... *School of Mines, Columbia College, N. Y., Fossil Flora.*
†F. B. Meek .... *Washington, D. C., Paleontologist of the Survey, Fossil Invertebrata.*
†Prof. Thomas C. Porter ...... *Lafayette College, Easton, Pa., Recent Botany.*
Dr. Elliott Coues .... *U. S. A., Ornithology.*
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P. R. Uhler .... *Baltimore, Md., Hemiptera.*
Dr. G. H. Horn .... *Philadelphia, Pa., Coleoptera.*
Dr. H. Hagen .... *Cambridge, Mass., Neuroptera.*
W. H. Edwards .... *Coalburgh, W. Va., Neuroptera.*
Baron R. Osten Sacken ...... *Cambridge, Mass., Diptera.*
E. T. Cresson .... *Philadelphia, Pa., Hymenoptera.*

‡ Honorary Members of the Survey.

S. R. Gifford .... 1870 ... *Artist, New York City.*
Thomas Moran .... 1871 ... *Artist, Newark, New Jersey.*
William Blackmore ... 1872 ... *Ethnologist, London, England.*
N. P. Langford .... 1872 ... *Superintendent Yellowstone National Park, St. Paul, Minnesota.*
W. D. Whitney .... 1873 ... *Professor Oriental Languages, Yale College, New Haven.*

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*Messrs. Batty, Stuckle, Taggart, Luce, Nealy, Holman, Cole, and Noonan, were attached to the survey of the United States while in the field.

† Messrs Leidy, Cope, Lesquereux, Meek and Porter have rendered most important services to the survey in the field in their special departments, and their contributions to the annual reports are of great value.

‡The qualifications for honorary membership of the survey are, viz: that the member shall have previously been eminent in some intellectual pursuit; shall have been an invited guest of the survey for at least one season; and during his connection with the expedition in the field, shall have displayed great powers of physical endurance.

The survey has also received the assistance of specialists in various departments of botany, as Prof. D. C. Eaton, Filices; Henry Willey, Lichens; C. H. Peck, Fungi; S. T. Olney, Cyperaceæ; Drs. Vasey and Thornton, Graminaceæ; and W. G. Binney, Land-Shells.

LIST OF THE PUBLICATIONS

OF THE

GEOLOGICAL SURVEY OF THE TERRITORIES.*

1. First, Second, and Third Annual Reports of Progress for 1867–8–9, pp. 261, 8vo.
2. Fourth Annual Report of Progress for 1870, (Wyoming, &c.,) pp. 511, 8vo.
3. Fifth Annual Report of Progress for 1871, (Montana, &c.,) pp. 538, 8vo., with sixty-four wood-cuts, two plates and five maps.
4. Sixth Annual Report of Progress for 1872, (Idaho, &c.,) pp. 844, 8vo. with sixty-eight wood-cuts, twelve plates and five maps,
5. Seventh Annual Report of Progress for 1873, in preparation, and will be issued early in 1874.
6. Final Report of the Geological Survey of Nebraska during the year 1867, pp. 264, 8vo., with a colored geological map and eleven plates of carboniferous fossils.

Miscellaneous Publications.

7. No. 1.—Lists of Elevations in that portion of the United States west of the Mississippi. Collated and arranged by Henry Gannett, assistant, pp. 47, 8vo. Second edition. A third edition of this important paper will be issued in a few months, very much enlarged and improved.
8. No. 2.—Meteorological Observations during the year 1872, Utah, Idaho, and Montana, prepared for publication by Henry Gannett, assistant, pp. 120, 8vo.
9. No. 3.—Hand-book of the Ornithology of the Territories of the Northwest, by Dr. Elliott Coues, U. S. A., (in press.)
10. No. 4.—Synopsis of the Flora of Colorado, by Prof. T. C. Porter and John M. Coulter, (in press.)
11. No. 5—Catalogue of Photographic Negatives belonging to the survey, by Wm. H. Jackson, (nearly ready.)
12. Supplement to the Fifth Annual Report, on the Fossil Flora of the West by Leo Lesquereaux, pp. 22, 8vo.
13. Synopsis of New Vertebrata from the Tertiary of Colorado, obtained during the summer of 1873, by Prof. E. D. Cope, pp. 19, 8vo.

Quarto Publications.

14. Vol. I. Contributions to the Extinct Vertebrata of the Western Formations, by Prof. Joseph Leidy, pp. 358, with thirty-seven plates.
15. Vol. II. The Vertebrata of the Cretaceous Formations of the West, by Prof. E. D. Cope.

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*Nos. 1, 2, 3, 4, 6, 7, 8, 12, 13, 14, and 18, are already published Nos. 9 and 10 are in press and will be issued in a few weeks. If success attends the efforts of the survey all the publications indicated in the list will be issued in less than two years, with several others not mentioned.

16. Vol. III. The Vertebrata of the Eocene Formations of the West, by Prof. E. D. Cope.
17. Vol. IV. The Vertebrata of the Miocene and Pliocene Formations of the West, by Prof. E. D. Cope.
18. Vol. V. Synopsis of the Acrididæ of North America, by Prof. Cyrus Thomas.
19. Vol VI. Contributions to the Fossil Flora of the Cretaceous and Tertiary Formations of the West, by Prof. J. S. Newberry.
20. Vol. VII. The Fossil Flora of the Cretaceous Formations of the Western Territories, by Prof. Leo Lesquereux.
21. Vol. VIII. The Fossil Flora of the Tertiary Formations of the Western Territories, by Prof. Leo. Lesquereux.
22. Vol. IX. The Fossil Invertebrata of the Western Territories, by F. B. Meek.
23. Vol. X. Sections, Profiles, and other Illustrations of the Geology of the Western Territories explored by the Survey, with descriptive text, by F. V. Hayden, U. S. Geologist in Charge. In three parts.
24. Sections, Profiles, &c., a portion of No. 23. Only 100 copies published—will be reproduced in No. 23.

MAPS.

Prepared by the United States Geological Survey of the Territories.

1871.

1. Yellowstone Lake.
2. Lower Geyser Basin of Firehole River.
3. Upper Geyser Basin of Firehole River.
4. Yellowstone National Park.
5. Parts of Idaho, Montana, and Wyoming Territories. Preliminary map for field use.

1872.

6. Map of the Lower Geyser Basin of Firehole River, resurveyed by Bechler in 1872, and beautifully engraved on stone, (scale 8 miles to 1 inch.)
7. Map of Upper Geyser Basin of Firehole River.
8. Map of Lake Henry and the Sources of the West Fork of Snake River.
9. Map of Shoshone Geyser Basin and Lake.
10. Map of the Sources of Snake River, (reduced from the final map.)
11. Montana and Wyoming Territories, embracing most of the country about the sources of the Madison, Gallatin, and Yellowstone Rivers, in contour lines. (Final map on a scale of 5 miles to 1 inch.)
12. Map of the Sources of Snake River and its Tributaries. (Final map scale 5 miles to 1 inch.)
13. Field map of Colorado based on the United States land survey, during the season of 1873.

PHILADELPHIA, *December* 18, 1873.

SIR: I send herewith a report on the stratigraphical relations and vertebrate paleontology of the formations which represent the Pliocene epoch, as at present understood, in Northeastern Colorado. This essay is based upon material collected by myself during a part of the summer of 1873, under the auspices of the Geological Survey of the Territories, of which you are director. Hoping that it will subserve the objects of the survey, I remain, with respect,

EDWARD D. COPE,
Paleontologist.

DR. F. V. HAYDEN,
Director of the U. S. Geological Survey of the Territories.

REPORT ON THE STRATIGRAPHY AND PLIOCENE VERTEBRATE PALEONTOLOGY OF NORTHERN COLORADO.

BY EDWARD D. COPE, A. M.

The water-shed between the South Platte River and the Lodge-Pole Creek, is composed superficially of formations of the Pliocene epoch, as defined by Hayden. The latter stream flows eastwardly through the southern parts of Wyoming and Nebraska, and empties into the South Platte near Julesburg, Nebraska. The Territorial and State boundaries traverse this water-shed from west to east. The springs on its southern slope, which form the sources of the northern tributaries of the South Platte, issue from beneath the beds of the formation above named. At or near this point is an abrupt descent in the level of the country, which generally presents the character of a line of bluffs varying from two to nine hundred feet in height. This line forms the eastern border of the valley of Crow Creek, until it bends to the eastward, when it extends in a nearly east and west direction for at least sixty miles.* At various points along it portions have become isolated through the action of erosion, forming buttes. Two of these at the head of Little Pawnee Creek are especially conspicuous landmarks, forming truncate cones of about nine hundred feet in elevation, as Mr. Stevenson of the survey informs me. They are called the Pawnee or sometimes the White Buttes. Near them stand two others, the Castle and Court-House Buttes.

The upper portion of this line of bluffs and buttes is composed of the Pliocene sandstone in alternating strata of harder and softer consistency. It is usually of medium hardness, and such beds, where exposed, on both the Lodge-Pole and South Platte slopes of the water-shed, appear to be penetrated by innumerable tortuous friable silicious rods and stem-like bodies. They resemble the roots of the vegetation of a swamp, and such they may have been, as the stratum is frequently filled with remains of animals which have been buried while it was in a soft state. No better preserved remains of plants were seen. The depth of the entire formation is not more than seventy-five feet, of which the softer beds are the lower and vary in depth from one foot to twenty. The superior strata are either sandstone conglomerate or a coarse sand, of varying thickness, and alternating relations; the conglomerate contains white pebbles and rolled Pliocene mammalian remains.

This formation rests on a stratum of white friable argillaceous rock of Miocene age, probably of the White River epoch, as I believe from the presence of the following species which I detected in it: *Hyaenodon horridus*, *H. crucians*; *Oreodon culbertsonii*, *O. gracilis*; *Poebrotherium vilsonii*, *Aceratherium occidentale*, *Hyracodon nebrascensis*, *Anchitherium bairdii*, *Palaeolagus haydenii*, *Ischyromys typus*, *Mus elegans*, etc. The formation extends to a depth of several hundred feet, and rests on a stratum of a fine-grained, harder, argillaceous rock of a dark-brown color. Some of its strata are carbonaceous, and contain vegetable remains badly preserved; others are filled with immense numbers of fresh and brack-

*See Berthoud Proceed. Acad. Nat. Sci., Phila., 1872, p. 48, where they are mentioned.

ish water shells, including oysters. I do not know the depth of this bed, but followed it to the southward until it disappeared beneath the Loess of the South Platte. The age of this formation is no doubt, in the main, identical with that which underlies the fresh-water basins of Dakota and Wyoming, according to Hayden, and concerning which difference of opinion exists among paleontologists. Mr. Conrad, to whom I have submitted a number of shells, pronounces them to be species of *Cyrena*.

Believing, as I do, that the evidence derived from the vertebrate remains requires the reference of the Bitter Creek Coal Series to the Cretaceous period,* and having pointed out on similar grounds that the horizon of the Great Lignite from which vertebrate remains have been procured on the Missouri River is undoubtedly Mesozoic,† although usually regarded as Tertiary, I suspect that the corresponding strata in Colorado will be found to pertain to the same section of geologic time.‡

It is thus evident that the relations of these three formations are similar to those observed by Hayden to obtain between the Lignite, White River, and Loup Fork epochs, in the West generally, and they are in all probability to be referred to as near to those horizons. Prof. Marsh has already stated the existence of the White River Tertiary in Colorado,§ but subsequently in describing the *Elotherium crassum* and other species,|| remarks that the formation "probably belongs to a different horizon."

In the Pliocene strata above described, mammalian remains are exceedingly abundant over limited areas, those of horses in an especial manner. Those obtained are as follows:

	Species.
Carnivora	4
Perissodactyla	8
Artiodactyla	7
Proboscidia	1
Testudinata	1
Total	21

The most important paleontological results are: (1) The discovery that the camels of this period possessed a full series of upper incisor teeth; (2) that the horses of the genus *Protohippus* are, like those of *Hippotherium*, three-toed; (3) that a *Mastodon* of the *M. ohioticus* type existed during the same period.

* See Proceed. Acad. Nat. Sciences Phila., 1872, p. 279.

† Extinct Batrachia and Reptilia of North America, 1869, pp. 40–98.

‡ Since the above was written and set up, I have obtained abundant evidence of the correctness of this induction. In examining a collection from this formation, made by one of my assistants, I find a series of Mesozoic genera of vertebrates as follows: Dinosauria, *Cinodon arctatus*, gen. et sp. nov.; *Polyonax mortuarius*, gen. et sp. nov.; *Agathaumas milo*, sp. nov.; Testuvinata, *Compsemys* sp.; *Trionyx* is also represented, and a genus of Crocodilia nearer to the cretaceous form *Bottosaneus* than any other, so far as the remains are indicative. *Cinodon* is a herbivorous saurian, to be referred to the *Hadrosauridæ*. The maxillary teeth are rod-like, with a narrow enamel face on the inner side, the remainder of the surface being like a rat-tail file. The teeth have no stem, and the successional crowns occupy an excavation on the posterior or outer side of the shaft. They push the functional teeth inwards and upwards, so that the grinding surface exhibits at one time a transverse section of three teeth, viz: an outer young crown, a middle worn crown, and an internal stump. Longitudinally, three teeth also exhibit the relative stages of protrusion, so that every third cross row is identical in character. Enamel smooth, with a medium keel, and entire margin. Various parts of the skeleton indicate an animal of the size of a horse.

§ Amer. Jour. Sci. Arts, 1870, p. 292.

|| Loc. Cit., 1873, p. 486.

List of Species.

CARNIVORA.

CANIS, sp. indet.

Represented by a portion of the left ramus of the mandible, which contains alveoli for and portions of I. 3, c. 1, and P. m. 4. The incisors are closely crowded by the huge canines, which have larger proportions than dogs generally, resembling more those of the bears, or large feline carnivora. The first premolar is one-rooted and separated by a long diastema from the canine. The second premolar is two-rooted and separated from the first by a short diastema. The third is also separated by a distema from the second, which exceeds that in front of the latter. The fourth follows the third immediately. The mental foramina are two, one large, below the first premolar, the other smaller, but little below the alveolar margin opposite the posterior margin of the second premolar.

	M.
Length of fragment	0.175
Length from incisors to P. 4	.095
Length basis of P. m. 3	.017
Length basis of P. m. 2	.013
Vertical diameter canine at basis	.029
Length symphysis	.075
Depth ramus at P. m. 2	.047

This large species is about as large as the *Canis haydenii* of Leidy, and differs from the type in the the anterior postion of the mental foramina, perhaps an individual variation. It is characterized among dogs, by the weakness of its premolars as much as by the strength of its canines.

CANIS SAEVUS Liedy, Anc. Fauna, Nebraska, p. 28.

TOMARCTUS BREVIROSTRIS Cope, Paleontological Bulletin, No. 16, p. 2.

MARTES MUSTELINUS, Cope, Paleontological Bulletin,* No. 14, p. 1. (*Aelurodon.*)

PERISSODACTYLA.

APHELOPS MEGALODUS Cope, Pal. Bull., No. 14, p. 1.

This large species and the *A. crassus*, Leidy, were very abundant during the Pliocene period in Western North America. Their remains are everywhere mingled with those of horses and camels. The former, and probably the latter, is to be referred to a genus distinct from both *Aceratherium* and *Rhinocerus* on account of the existence of but three premolar teeth in the mandibular series, and probably in the maxillary also. One of our specimens exhibits the missing superior premolar on one side. The outer incisor below, is a large tusk, while the inner is small and caducous, points in which this genus resembles the genera above-named, and differs from the African and tichorhine species, or genus *Atelodus* of Pomel.

A posterior upper molar represents the *A. crassus* in the original collections described by Leidy. A well developed tubercle which rises from the bottom of the valley between the inner extremities of the

* These publications may be procured at the Naturalists' Agency, Salem, Mass., or of the writer.

cross-crests in the last and penultimate molars of *A. megalodus* is wanting in the *A. crassus*; partly on this account I refer my second large Pliocene rhinoceros to the latter.

APHELOPS CRASSUS Leidy, Anc. Fauna, Nebr., &c., p. 228.

Leidy states that the formula of dentition of this species is identical with that of the Indian rhinoceros, and elsewhere that it is probably a true rhinoceros as distinguished from *Aceratherium*. He does not appear to have possessed material to verify these statements.

An imperfect mandibular ramus containing the last molar and alveoli of the four teeth which precede it, differs from the corresponding one of *A. megalodus* in the greater thickness in proportion to the depth. It is absolutely both shallower and thicker than a corresponding ramus of the allied species, while the teeth are larger, the last three occupying exactly a space equal to that supporting the last four of *A. megalodus*. The last molar s larger than the penultimate in *A. crassus* (larger in *A. megalodus*) and encroaches on the base of the coronoid process; in all the jaws of *A. megalodus*, this tooth is considerably in advance of this process, which rises more abruptly than in it. This tooth is shown to be the last molar, by the absence of any trace of alveolus or crown of a successional tooth behind it in the various jaws in question. In *A. crassus* the coronoid process rises gradually from the front of the last molar.

	A. megalodus.	A. crassus.
Length last four molars	.160	.215
Length last molar	.044	.062
Length first true molar	.036	.055
Width first true molar	.028	.033
Depth ramus at m. 2	.087	.078
Width ramus at m. 2	.047	.055

The last molar is not quite protruded in the type specimen of *A. crassus*.

Near to the specimen just described, I found the left maxillary bone with nasal, frontal, and other elements of a rhinoceros which differ in some respects from corresponding parts of *A. megalodus*. The rather larger teeth would coincide with the type of *A. crassus*, but that the specimens belong to the same individual is not certain. It is charcterized by the same increase in size posteriously of the molars, the M. 2 exceeding that of *A. megalodus*, while the P. m. 2, (the first,) is considerably smaller. The latter measures less than half M. 2, while it is .8 the diameter of the same in the *A. megalodus*. There is no rudiment of P. m. 1, hence this specimen displays fully the characters of the genus *Aphelops*. The nasal bones are long, acuminate, straight, and not coössified. They are tectiform, and distally compressed, instead of flattened, as in two specimens of *A. megalodus*; they are also quite rugose at the extremity. These characters may be only sexual. As in *A. megalodus*, they did not support a horn.

HIPPOTHERIUM SPECIOSUM Liedy, Anc. Fauna, Dakota, Nebraska, p. 282.

HIPPOTHERIUM PANIENSE, sp. nov.

Indicated by molar teeth in the collection. Two of these have elongate curved crowns; the longer is a left posterior, the more abraded a right median. The latter is characterized by the generally greater

simplicity of the enamel boundaries of the lakes as compared with the same portions of *H. speciosum*, with which it agrees in size. The only plications to be observed are the usual opposite ones entering the lakes from the middle of their adjacent boundaries, and a slight one at their inner angle of the same border of the anterior lake. The inner crescents are united, the posterior retaining its width posteriorly and giving off the posterior inner column from its anterior half. Both the internal columns are longitudinally oval and rather small, the anterior well separated. The adjacent enamel border gives off the usual projecting fold. Outline of crown nearly quadrate.

A second molar, less worn, presents therefore a little greater complexity of enamel folds. Thus the anterior inner part of each lake is folded into a loop, and there is a second pair of opposite folds outside the usual pair on the adjacent borders of the lakes.

A third molar is much more worn than either of the preceding, so as to throw the inner and median posterior areas together. The anterior median is well isolated and subround. There are no folds of the enamel plates whatever.

	m.
Length No. 1 from roots	.027
Width of anteroposterior	.019
Width of exterointerior	.020
Length No. 2	.032
Width of anteroposterior	.021
Width of exterointernal	.018
Length No. 3	.018
Width of anteroposterior	.021
Width of exterointerior	.022

From the neighborhood of the Pawnee Buttes, Colorado.

PROTOHIPPUS LABROSUS. Sp. nov.

Having obtained a number of fragmentary and entire crania referable to species of the present genus, it becomes possible to correlate the mandibular with the maxillary forms, dentition, etc., as it has not been possible to do heretofore. Of mandibles there are four types, which refer to species as follows: Symphysis, flat, shallow; no diastema between their incisor and canine teeth; *P. labrosus*. A diastema, in front of canine; symphysis narrower, deep; inferior molars smaller; *P. sejunctus*. Symphysis narrow, deep, contracted, and smaller; lower molars larger; *P. perditus*.

These comparisons are instituted on one mandible of the first, two entire and three incomplete ones of the second, and two of the third types, all but two accompanied by superior molars or crania.

The specimen of *P. labrosus* embraces also the right maxillary bone, containing five molars; a second specimen includes three superior molars of the left side; it is also represented by several isolated molars.

Protohippus labrosus resembles the two species described by Leidy as Merychippus, in the short crowns and long roots of the molar teeth, with thickened external ridges separated by thin bands of cementum. It therefore differs from *Protohippus perditus* and *P. placidus*, resembling the first named in size. It is exactly intermediate between the *P. insignis* and *P. mirabilis* in size, and to it is no doubt to be referred Dr. Leidy's No. 4 of the latter.* Either there are three species of the present char-

*Ancient Fauna Dakota and Nebraska, p. 300; figured pl. xvii, figs. 8–9.

acter, or Dr. Leidy's and the present forms must be arranged under one appellation. I prefer retaining them as distinct for the present, since I have nearly identical measurements in six different individuals and four of the *P. perditus* equally uniform in dimensions. The latter always slightly exceed those of the *P. labrosus*, and differ in the longer dental crowns, with subacute exterior ridges; typically the internal columns are oval in section but may occasionally be subcylindric; they are cylindric in *P. labrosus*. The first specimen above mentioned I regard as typical, and describe it as follows:

The first premolar is well developed; in the first molar the anterior lake is isolated from the inner fold. The anterior inner column is cylindric in all the teeth; the posterior similar, but joint with its crescent by attrition in most of them. The boundaries of the crescents are all simple, except a tendency to the middle infolding of the adjacent borders of the crescents. The teeth are but little curved, and the base of the crown, with termination of the broad longitudinal gutters, is visible, although the attrition of the teeth, especially of the inferior incisors, does not indicate advanced age.

The mandible is distinguished by the length of the diastema and the flatness and shallowness of the symphysis. The permanent molars are all present in the specimen, and are robust in form. Except in the first and last, they are characterized by the small development of the anterior crescent horn and posterior tubercle of the inner side of the crown. The horn of the anterior crescent of the first molar is well produced inwardly, broad and simple. The entire tooth is narrower than the other molars, except the fifth and sixth. The latter is a little longer than the others, and possesses a posterior crescent smaller than the others. The canines issue from their alveoli very close to the third incisors. The two pairs of first and second incisors are in a nearly transverse line, in consequence of the flatness of the symphysis. The median lake is half worn out in the second incisors.

Measurements.

	M.
Length four premolars and one molar	.087
Length crown, first premolar	.008
Length crown, second premolar	.022
Width crown, second premolar	.019
Length crown, first molar	.018
Width crown, first molar	.022
Height crown, first molar	.011
Length six inferior molars	.113
Length first inferior molar	.020
Width first inferior molar, (medially)	.009
Length second inferior molar	.019
Width second inferior molar	.012
Width symphyseal trough, (least)	.015
Depth in front *foramen mentale*	.106
Expanse of two middle pairs of incisors	.041

About the size of the ass.

This species is readily distinguished from the more common *P. perditus* by the peculiar form of the symphysis, more simple molar teeth with shorter crowns, and the constantly smaller size; four mandibular teeth of the latter occupying the same space as five mandibulars in the *P. labrosus*. The first premolars are also larger and two-rooted; those of *P. perditus*, in three specimens before me, and of *P. sejunctus*, in one example, being but one-rooted.

PROTOHIPPUS SEJUNCTUS, sp. nov.

Represented in my collections by a nearly complete skeleton with cranium and entire dentition, both mandibular rami and symphysis of a second; mandibles and dentition of two others, with appropriate molar teeth.

The skeleton, which I excavated with my own hands from the side of a bluff, adds considerably to our knowledge of this genus of horses. The side of the cranium displays a considerable depression in front of the orbit, which, though not so deeply impressed as described by Doctor Leidy in the known species, will refer this animal to the group regarded by him as a genus under the name of *Merychippus*. That the latter is distinct as a genus may be questioned, and I shall follow Doctor Leidy's later conclusion in uniting them.*

The structure of the feet in this genus, as indicated by the specimens of the present species, and of the *Protohippus placidus*, proves to be identical with that of *Hippotherium*, i. e., tridactyle, the lateral toes of reduced proportions. This is important as distinguishing the genus trenchantly from *Equus*, and while the union of the inner columns of the superior molars distinguishes it from *Hippotherium*, a form of *P. perditus* is described below, in which the columns are more distinct than in individuals heretofore known.

The *P. sejunctus* is identical in measurements with the *P. labrosus*, and agrees with it in the simplicity of the enamel boundaries. It is also a short-crowned, but the character is not so marked as in the latter. It differs strikingly in the deep and convex symphysis, and, in the only specimen in which its alveolar border is preserved, in the hiatus separating the inferior canine from the incisors. It exhibits, also, the small and one-rooted first premolar of the *P. perditus*.

The adjacent horns of the lakes of the molars are more produced outward than the remote ones, and the enamel borders have no plications. The sections of the inner columns are oval posteriorly and subround anteriorly. The wearing of the last molars indicates the full maturity of the animal. The canines are separated by a considerable interval from the third incisors. The inferior molars are similar, in general, to those of *P. labrosus*. In three individuals the last lobe of the last molar is a cylindroid instead of a trough-shaped column.

The cranium, in general form, partakes of the shorter and more elevated outline seen in all the three-toed horses. The fore-part of the nasal-bones and the diastema behind the canines are short. The outline of the vertex from the nose to the sagittal crest is quite plane, while the posterior part of the nasal bones, etc., are much narrowed by the large facial depression at the sides. This occupies the space between the nasal-bones and the molar ridge, above and below, and is bounded behind by the anterior border of the orbit. In front it is open, but its depression follows below the nasal-bones to the diastema. While its area is strongly impressed, especially superiorly and inferiorly, it is not nearly so much so as indicated by Leidy in *P. insignis* and *P. mirabilis*, but more marked than in his figure of *P. perditus*. My specimens of the latter are not well preserved in the region in question.

The infraorbital foramen issues above the anterior border of the first true molar and the molar ridge above its posterior portion. The orbit is closed behind and the sagittal crest is but an angle, and originates above the glenoid cavity. The inion is narrowed above and projects backward over the upper edge of the foramen magnum. Posteriorly the

* See Quarto report on Geological Survey of the Territories, 1873, vol. I, p. 322.

occipital presents a pair of vertical fossæ separated by a low ridge. Its external crest is not continued to that of the squamosal part of the zygoma. The meatus auditorius is quite small, as is, also, the mastoid tuberosity. The paramastoid is large and stout.

Measurements of cranium.	M.
From occipital condyle to incisor teeth	0.330
From occipital condyle to last upper molar	.140
From occipital condyle to fundus of palatal notch	.165
Length of entire molar series	.124
Length crown P. m. 1	.011
Length crown P. m. 2	.025
Width crown P. m. 2	.018
Length crown first true molar	.017
Width crown first true molar	.020
Height crown first true molar	.013
Length diastema	.027
Height crown of canine	.015
Width of arc of incisors	.050
Length from I. 1 to P. m. 1	.069
Length from I. 1 to nasal-notch (oblique)	.080
Length from I. 1 to orbit	.198
Diameter of orbit	.045
Width nasals at notch	.031
Width front at middle orbit	.076
Width of zygomata posteriorly	.132
Width between meatus	.088
Width between middle molars	.038
Width of occipital foramen and condyles	.054
Length mandibular ramus	.270
Length from end incisors to last molar	.190
Length from end incisors to first molar	.077
Length from end incisors to canine, (axial)	.025
Depth symphysis in front of *foramen mentale*	.028
Depth ramus at M. 1	.043
Depth ramus at M. 6	.063

The *skeleton* is noteworthy for the disproportionately large size of the cervical as compared with the dorsal vertebræ. The large size of the head, compared with the rest of the animal, was supplemented by the length and slenderness of the limbs, which considerably exceeded the proportions they bear in the existing horse. The lumbar vertebræ are slightly opisthocoelian—the dorsals strongly so. The cervicals are large and moderately elongate. The size results from the great development of the processes, since the centra do not materially exceed those of the lumbars. The atlas is not much expanded, and has a well-marked *tuberculum atlantis*, and very low neural keel.

The limbs are slender and the hoof small. The humerus is more curved than in the horse, and has a strong tubercular deltoid crest. The proximal tuberosities are very different from those of the horse. The external is largely developed, but is not produced into a hook, nor extended into a longitudinal crest. The inner bicipital tuberosity is a little more prominent and curves hook-like outward, inclosing with the outer, a deep notch. It is continued at right angles along the inner aspect of the head into a straight crest, their angle of union is

prolonged downward as the deltoid crest. The outer tuberosity in the horse is double, and while not hooked as in the *rhinoceros*, is a little more prominent than in the present species; the inner is not hooked as in the *P. sejunctus*. There is an ala on the inner side of the distal end of the humerus, and a supracondylar foramen, both of which are wanting in the horse.

The *radius* differs from that of the horse, in being considerably longer than the humerus, instead of a little shorter. It is gently curved and flattened, with the transverse ends about equally wide. The ulna is coösified with it throughout the length, excepting a small portion be yond the humeral cotylus, as in the horse.

The *femur* is stout, with the lesser trochanteric ridge well developed. The trochlea is wide, with subequally elevated bounding ridges. The *tibia* is considerably longer than the femur, and presents a long and prominent cnemial crest. The shaft is transverse, with external edge and inner plane narrower than the anterior. The trochlear is very oblique; the astragalar grooves well defined by the internal and external tuberosities. Fibula not preserved.

The right posterior foot, among others is perfectly preserved. It is like the radius and fore foot, and the tibia, distinguished for its elongation and slender proportions, as compared with the horse. The *astragalus* differs from that of the horse in having the cuboid facet on a more pronounced neck, and in the narrowness of the trochlea. The navicular facet is subpentagonal and without emargination. The *cuboid* is largely extended posteriorly where it bears a large tuberosity. The *naviculare* is shallow and concave proximally. The *ectocuneiforme* is of similar length; behind it a well developed *mesocuneiforme* which supports the internal metatarsal. The external metatarsals are situated behind the median except for an inch at their distal extremities. Their articular surfaces are compressed, and present an obtuse trochlear angle but no keel; they reach to the base of the condyle of the median metatarsal behind. The latter is very convex above, slightly flattened below. The lateral digits only reach to the distal end of the first phalange. The penultimate phalange of each is much produced behind; the last or ungueal, is much compressed, and is literally a half-hoof. The coronet is half as long as the pastern, and the unguis or coffin-bone is acuminate in outline and elevated on the middle line. It is deeply fissured at the extremity, and the margin abounds in foramina. The nutritious foramina of the base are each in the apex of a triangular fossa which is open posteriorly. This bone has proportions not unlike those ascribed by Leidy to a specimen from the Niobrara, but is rather smaller; but the foot to which it pertains measures but 10.5 inches, while that of *P. sejunctus* (without tarsals) is eleven inches in length.

Measurements.

	M.
Length of atlas (extreme)	0.061
Width of atlas, medially below	.035
Width of atlas in front of diapophyses	.060
Length of odontoid process	.023
Length of three posterior dorsal vertebræ	.076
Diameter of articular face of centrum, (transverse)	.021
Diameter of articular face of centrum, (vertical)	.015
Length of humerus (axial)	.192
Diameter proximal end, (anteroposterior)	.065
Diameter proximal end, (transverse)	.055

	M.
Diameter proximal end, (condyles)	.044
Length radius	.220
Transverse diameter (proximally)	.045
Transverse diameter (at middle)	.026
Transverse diameter (distally)	.038
Anteroposterior diameter (proximally)	.025
Anteroposterior diameter (medially)	.018
Anteroposterior diameter (distally)	.023
Diameter femur, (shaft)	.040
Diameter femur (condyles)	.058
Length tibia	.250
Length foot including tarsus	.325
Length foot without tarsus	.277
Outside length of calcaneum	.075
Depth of calcaneum behind	.027
Width of calcaneum in front	.033
Total length astragalus	.045
Total width astragalus	.041
Width trochlea astragalus	.018
Width navicular facet	.022
Depth navicular facet	.022
Width cuboid facet	.008
Width cuboid bone fore and aft	.023
Length cuboid bone	.015
Length internal metatarsus	.170
Transverse width trochlea of median metatarsus	.021
Length pastern	.042
Width posterior (proximally)	.025
Length coronet	.027
Width coronet (proximally)	.025
Length coffin	.036
Width articular face	.021
Width between angles	.030
Elevation behind	.023

Remarks. Professor Leidy has already observed that the structure of the molars in this genus is in its type the same as that of the deciduous molars of *Equus*, and that hence, that *Protohippus* represents the more primitive condition of horse. In further confirmation of this view, I may add that the proportionate size of the head and length of limbs to size of body is greater in this species than in the recent species of *Equus*, resembling in these points the colts of that genus. Acceleration of the growth of the body and prolongation of the face, the same in the widening (fore and aft) of the internal columns of the molar teeth, with retardation of the growth of the lateral phalanges, would express the process of evolution of the modern types of horse.

PROTOHIPPUS PERDITUS Leidy,

Represented in the collections by the entire molar dentition of one cranium; the greater part of that of another with incisors and canines; the four median molars of another, two superior molars with mandible and teeth of a fourth; mandibular dentition of a fifth, with parts of mandibles and symphyses and isolated molars of a large number of other specimens.

Without this material, I should have hesitated to separate the two species above described as new; as it is, I have no question that they are well defined, and are not the species described by Dr. Leidy, under the name of *Merychippus*. The two lower jaws at my disposal agree in dimensions with each other, and with the superior molars, and with Dr. Leidy's types with which I have compared them, four of them having the same extent as five of those of the two species above described. In two successional superior molars little worn, one of the inner columns (the anterior) is not yet united with its corresponding crescent, and the borders of the lakes are more plicate than in more worn examples.

PROTOHIPPUS PLACIDUS Leidy—

A portion of the skeleton of this species was excavated by myself from the rock of the Pliocene formation, which was accompanied by two teeth characteristically those of this species, and the only ones I obtained which are referable to it. They are readily known from their small size absolutely, and it would seem relatively also. The vertebræ are similar in size and proportions, but the metatarsus is materially shorter than that of *P. sejunctus*, and the phalanges of all the toes, and especially the coffin-bones, considerably stouter. Compare measurements with those given above.

Measurements.

	M
Length median metapodial bone	.17
Expanse of condyles of lateral metapodials	.042
Length of fist lateral phalange	.024
Antroposterior width of first lateral phalange	.016
Length of coffin-bone medially	.041
Width between angles	.037
Width of articular face	.026
Height of coffin-bone behind	.022

Thus both coffin-bones are larger, wider, and flatter than those of *P. sejunctus*, a character provided for by the greater, lateral distal expansion of the metapodial bones. The shortness of the metapodial bone is not due to the fact of its being a metacarpal; the femoral condyles are adherent to it in the matrix, and there are proximal facets for the ento- and meso-cuneiform bones. Were the bone a metacarpal, this facet would relate to the trapezoides, a contact which does not exist in either of the genera of the three-toed horses, *Hippotherium* and *Anchitherium* according to Kowalesky*.

ARTIODACTYLA.

MERYCHYUS MAJOR Leidy Anc. Faun. Dac., Nebr., 121.

A single superior first molar presenting some peculiarities, perhaps individual.

MERYCHYUS ELEGANS Leidy, Loc. Cits., p. 118.

A mandibular ramus with the molars and last premolar; a little larger than Leidy's specimens from Nebraska.

PROCAMELUS, sp.

Numerous parts of skeletons of a large species without teeth; possibly the *P. niobrarensis* Leidy.

*Palaeontographica 1873, Pl. VII.

PROCAMELUS ANGUSTIDENS, Sp. nov.

Represented by the nearly entire mandibles, with most of the teeth of two individuals, and two superior molars referred, with probability, to the same.

This camel is the size of the *P. robustus* Leidy, but differs from it in the much narrower teeth, especially the last molar and last premolar, the much smaller first molar, and totally different form of the second premolar. Thus, while the last molar has the same length, it supports an anterior expansion, whose angles are the summits of ridges on the inner and outer sides of the crown, which are wanting in *P. robustus.* Behind the outer rib in *P. angustidens* there is a considerable groove. While the M. 3 is as large as that of *P. robustus*, the M. 1 is strikingly smaller; while the P. M. 3 is about as long, is only half as wide when worn to the same degree. The second premolar, instead of presenting a contracted subconic crown, is longitudinally extended and compressed, resembling closely the third premolar. The molars are remarkably flat on the outer side, each lobe being devoid of a median ridge, and the first and second even wanting that between the lobes. The diastemata are long, and the first premolar is compressed and equi-distant between the canine and the second premolar. The diastema in front of the canine is not wider than one tooth. The lower incisors are broad and oblique. The lower posterior boundary of the symphysis is almost immediately below the first premolar.

Measurements.

Total length of dental series to I. I	0.240
Length from first to third incisor on crowns	.035
Length from first incisor to canine	.040
Length from first incisor to first premolar	.073
Length from first incisor to second premolar	.103
Length of molar series	.134
Length of pre-molars 2, 3, 4	.039
Length of second premolar	.010
Length of fourth premolar	.016
Width of fourth premolar, (half worn)	.005
Length of first molar, (half worn)	.019
Width of first molar, (half worn)	.014
Length of third molar	.047
Width of third molar, anterior column	.013

In the second specimen the molars are a little narrower.

PROCAMELUS HETERODONTUS sp. nov.

Represented by the right distal portion of a mandibular ramus, with incisor, canine, and premolar teeth, and by the greater part of the dentition of the premaxillary and maxillary bones. These indicate an animal of the size of the species last described.

An interesting fact in the structure of the genus is indicated by these specimens, namely, that the premaxillary bones support a full series of incisor teeth, a fact not heretofore known, as the pieces in question have not been previously identified by authors. The median incisors were inserted into rather small sockets and were separated by diastemata from the third or caniniform incisor, from each other, and from the anterior extremity of the bone.

A second result of the investigation is that the genus *Homocamelus* Leidy is probably the same as *Procamelus*, and that *H. caninus* should be regarded as the *P. robustus*, unless new evidence exists to the contrary. The former was established on dentition of the upper series

alone; the latter on that of the lower jaw. In the present species we have the two kinds of teeth combined. The relations are, however, quite different from those found in the *P. robustus* and the *P. angustidens*. As to the reference of *H. caninus* to the former rather than the latter of these two, it depends on their coincidence in the transverse width of the premolar teeth, and is rendered probable by the fact that they are from the same horizon and approximate locality.

In the superior and inferior dentition of *P. heterodontus*, it is to be noticed that the first premolar is situated well anteriorly, the space separating it from the second premolar being twice as long as that between it and the canine. In *P. robustus* these interspaces are equal, (in the lower jaw,) as in *P. angustidens*. In the present camel the third incisor is separated from the canine, in the lower jaw, by a space nearly equal to that between the canine and first premolar; in *P. angustidens* (and probably *P. robustus* and *H. caninus*) this space is very much less, and just sufficient to admit the superior caniniform incisor. In the present species the lower border of the symphysis is below the canine, and hence the symphysis is much shorter than in *P. angustidens*, as it is steeper and concave on the anteroinferior face. It is not co-ossified in the specimen, while it is so in the *P. angustidens*. On each side of the suture below is a small compressed descending tuberosity. The mental foramen is below the first premolar. The second and third lower premolars are two-rooted and compressed; the third presents an angle inward at its anterior end.

The premaxillary bones are attenuated and simple in front, with little indication of contact or connection across the middle line. The side of the muzzle is concave above the first premolar. Last incisor vertical in direction.

The maxillary teeth associated with the above-described premaxillary bones represent the entire series except the second and third premolars. These present strong exterior ribs between the columns, and weak ones between, on the third molar. These teeth present no extra lobes, tubercles, nor columns, and the cement deposit in the lakes is very small. The P. M. 3 and M. 1 are each about as broad as long.

Measurements of upper jaw.

	M.
Length true molars	0.083
Length last molars, (outside)	.036
Width last molars, (anterior column)	.016
Length of first molar	.020
Width of first molar	.019
Length of last premolar	.014
Width of last premolar	.013
Length from P. M. 1 to canine	.016
Length from P. M. 1 to I. 3	.036
Length from I. 3 to end of premaxillary	.038

Measurements of lower jaw.

Length from apex I. 3 to end P. M. 3	.120
Length from apex I. 3 to P. M. 2	.098
Length from apex I. 3 to P. M. 1	.052
Length from apex I. 3 to canine	.025
Depth at P. M. 3	.040
Depth at canine	.041

From the heads of Pawnee Creek, Colorado.

PROCAMELUS OCCIDENTALIS Leidy, Anc. Fauna Dakota and Nebraska, p. 151.

Specimens in fine preservation, but referred with some doubt as above. The dimensions of the teeth are intermediate between those of the species above named, and the *P. gracilis*, Leidy.

MERYCODUS GEMMIFER, sp. nov.

A small ruminant represented by jaws and teeth of three individuals found in association with the species above described by the writer. These embrace only the true molar teeth in good preservation, They resemble those of *M. necatus*, Leidy, in form and size, but differ in having a rudimental column between the principal columns at their bases, a character which I have satisfied myself does not exist in the Niobrara specimens described by Dr. Leidy, by autopsy. These only appear on the grinding faces after prolonged attrition. First molar equal to the last premolar in anteroposterior diameter.

Measurements.

	M.
Length of four posterior molars	0.037
Length of true molars	.030
Length of second molar	.090
Width of second molar	.040
Length of third molar	.013
Width	.006
Depth of jaw at second molar	.015

PROBOSCIDIA.

MASTODON PROAVUS, Cope. Synopsis Vertebrata, Colorado, 1873, p. 10.

TESTUDINATA.

STYLEMYS ?NIOBRARENSIS, Leidy. Abundant.

SUPPLEMENTARY ADDITIONS

TO THE "SYNOPSIS OF NEW VERTEBRATA, FROM THE TERRITORY OF COLORADO, 1873."

MENOTHERIUM LEMURINUM, gen. et sp. nov.

This new genus is probably quadrumanous, and allied to the lemurs, but as I only possess portions of two mandibular rami with dentition, a more exact determination will be looked for with interest. It is the first indication of the existence of monkeys in the Miocene formation of the United States.

There are at least two premolars and three molars in the inferior series, those anterior being last in the specimens. The last premolar is somewhat sectorial in form, having a compressed but stout median cusp, a broad heel behind, and a small tubercle in front. The last molar is rather smaller than the others, and with a slight posterior or fifth tubercle. The molars support four tubercles nearly opposite in pairs, and connected by a diagonal crest, so that when the crown is worn an S-shaped figure results. The two alveoli in front of the last premolar may have contained each a separate tooth, or a single tooth, longer than any of the others.

Char. specif.—The last premolar is longer than any of the molars. There are no cingula on the molars, but the transverse crest from one of the tubercles descends to the side of that opposite to it, along the end of the crown; enamel smooth; ramus of the jaw rather elongate.

Measurements.

	M.
Length of bases of six molars	0.0250
Length of bases of true molars	.0120
Length of bases of first true molar	.0040
Width of base of first true molar	.0032
Length of basis of last premolar	.0052
Width of basis of last premolar	.0030
Depth of ramus at last premolar	.0090

This animal was about as large as the domestic cat.

ISACIS CANICULUS Cope, Paleontological Bulletin, No. 16, p. 3.

This genus is intermediate between the *Leptictis* and *Ictops* of Leidy, so that either one genus must be recognized or three. The superior molars have the some constitution, with specific resemblances to *Ictops dacotensis*; but the last premolar, while possessing an internal cusp, as in that genus has but one, a narrow, conic tubercle on the outer side, as in *Leptictis.*

HERPETOTHERIUM FUGAX Cope.

The dental formula given for this genus (synopsis New Vertebrata, &c., p. 4) embraces the figures Incisors $\frac{4}{4}$. This is a typographical error for $\frac{?}{4}$. (I did not have opportunity of reading the proofs.)

HOPLOPHONEUS OREODONTIS Cope; *Machaerodus oreodontis* Cope; synopsis New Vert. Colorado, 1873, p. 9.

Char. gen.—Dental formula of mandible: I. 3; C. 1; P. M. 2; M., 2. Superior canine greatly developed; end of mandible expanded and thickened to protect it.

This is simply *Machaerodus*, with a tubercular molar, as in *Dinictis.* The dental formula is the same as that of *Bunaelurus*, but the latter probably has the character of *Felis* in its anterior dentition, though this is not absolutely certain.*

Char. specif.—The species was established on a young individual with part of the temporary dentition remaining. A jaw of an adult furnishes additional characters. The first premolar (the third) has two roots, and is as large as the second, instead of being smaller, as in *Machaerodus primaevus.* The second (fourth) has a prominent anterior basal tubercle, as in the last-named species, but which is, according to Leidy, wanting in *Dinictis felina.* The anterior angle of the mandible is not produced downward so much as in the *Machaerodus*, but is more as in *Dinictis felina*, with which the present species agrees nearly in size.

POËBROTHERIUM HALLII. *Protomeryx hallii* Leidy, Anc. Faun., Nebr., &c., p. 160.

This species agrees closely with *P. vilsonii* in dental characters, differing only in the rather larger size, so far as the portion of the jaw of the type furnishes indication.

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* One or the other of these genera may perhaps be found to be the *Aelurogale* of Delfortrie, but I have not yet seen its diagnosis.

POËBROTHERIUM VILSONII Leidy, l. c., 141.
Several specimens obtained. This genus differs from *Amphitragulus* Pom., in the association of the first premolar, with the canine and incisors, rather than with the remaining premolars. Dental formula: I. 3, C. 1; P. M. 4; M. 3. The diastema between the first and second premolars only; canine more or less approximated to the first incisor.

The osteology of this genus presents a number of interesting features. The cranium only has been described by Professor Leidy. The following observations are based on portions of a skeleton, which include the maxillary, and part of the mandibular, and other cranial bones, which I extricated from the matrix myself. The dentition agrees with that figured and described by Leidy.

The *atlas* is rather broader than long, with thin diaparapophyses, pierced by the usual foramen at the middle of the base, and produced well backward at the outer margin. The articular facets of the axis are continuous below the foramen dentati. The neural arch is regularly convex, and without keel on its posterior .4, but the anterior .6 consists of a flat facet, descending obliquely to the neural canal, with a median keel and prominent lateral angle, descending to the base of the diapophysis in front. The third and fourth cervical vertebrae are enlarged, and quite elongate, and present the usual peculiarity of the *Camelidae* in the position of the canal for the vertebral artery. It perforates a part of the base of the neurapophysis, and not that of the diapophysis. The latter is a decurved lamina, extending the entire length of the centrum, and sends a strong angular ridge from the posterior outer angle to the anterior zygapophysis. The zygapophyses are connected by a strong longitudinal angular ridge. The neural spine is a prominent keel of no great elevation. The hypapophysis is an acute keel, low in front, but produced downward and backward to a rugose obtuse extremity. The centra are slightly opisthocoelian, the articular surfaces so moderately interlocked as to constitute a form intermediate between that of the camels and of the *Macrauchenia*. An anterior dorsal vertebra is more strongly opisthocoelian, resembling that of the lama. The diapophysis has a reniform tubercular surface, which looks downward; from its posterior inferior angle a strong fold-like ridge originates, and is continued as the posterior margin of the neural arch. Below the capitular facet a short ridge originates, which incloses a median fossa with its fellow on the anterior half of the centrum. A lumbar exhibits a strongly depressed centrum and the absence of an epiphysis from it, and from the dorsal described, indicates the immaturity of the individual.

The *humerus* is little expanded distally, and is truncate from the trochlear margin on the inner side. The posterior portion of this face is produced into a strong tuberosity, of which a trace may be observed in the lama, which prevents the extension of the forearm beyond an angle of 180°. The inner trochlear face has the greater sweep and less width, and is uninterrupted; the outer is wider, and is divided into two nearly coincident planes. There is a supracondylar foramen.

The forearm is long and slender, and the *ulna* coössified its entire length, except a foramen near its distal end. The medullary cavities of the two bones are separated for the proximal half of their length. A shallow groove distinguishes the ulna proximally, and at the middle of the shaft the latter forms an acute edge. Distally the combined bones present three planes, two lateral and a median. The lunar facet is most impressed; the scaphoid and unciform are equally prominent.

The *carpus* consists of eight bones, the entire mammalian number, all entirely distinct. The second series presents the most important peculiar-

ities. The *trapezium* is small and posterior; the *trapezoides* has an almost entirely lateral presentation, and is also small, and fits an angle of the magnum; the metacarpal facets of the latter bones are continuous and uninterrupted. The *magnum* is flat and transverse; the *unciform* is nearly as broad and less depressed; it presents two inferior articular faces, the lesser and interior for the third metacarpal; that for the fifth metacarpal is wanting.

There are two principal and two rudimental *metacarpals*. The third articulates with half of the trapezoides, the magnum, and a fourth of the unciform; the fourth with the remainder of the unciform. The second and fifth are very short and wedge-shaped, and closely adherent in shallow fossae of the third and fifth respectively. The latter are distinct, and present no traces of present or prospective attachment; their opposed faces are only flattened on the proximal three-fourths, and rounded on the remaining fourth. Their articular extremities present no basal ridge, and the median keel is posterior, terminating at the distal center. The basal *phalanges* are short, and with a distal trochlear groove; those of the second series are half as long.

Measurements.

	M.
Length of the continuous six molars	0.058
Depth of mandible at M. 2	.022
Length of atlas, (on centrum)	.035
Length of third cervical vertebra	.056
Width of centrum behind	.020
Depth of centrum behind	.015
Depth of centrum behind with hypapophysis	.020
Expanse of diapophyses of fourth cervical	.034
Expanse of zygapophyses of fourth cervical	.038
Length of centrum first dorsal	.025
Width of centrum first dorsal	.020
Depth of centrum first dorsal	.014
Width of humerus distally	.024
Length of radius	.183
Width of do. proximally	.018
Width of do. distally (greatest with ulna)	.023
Length of lunar, (anterior face)	.009
Length of magnum, (anterior face)	.004
Width of carpus distally	.020
Width of III and IV metacarpals proximally	.019
Width of III metacarpal proximally	.011
Width of III metacarpal distally	.009
Length of III metacarpal	.131
Length of proximal phalange	.017
Length of phalange of second row	.010

The above analysis determines some interesting relations of this genus. The cervical vertebræ indicate affinity to the *Camelidæ* and there is nothing in the remainder of the structure to contradict such relation. The separation of the *os trapezoides* is found in the camels and very few others only among *Ruminantia*, but in the presence of the *trapezium* *Poëbrotherium* shows relationships to more ancient types as *Anoplotheriidæ*, &c. The reduction of the digits to two, and the separation of the metacarpals point in the same direction; indeed the number of carpals and metacarpals is precisely as in *Xiphodon*. But the mutual relations

of these bones are quite different from what exists in that genus, and is rather that of the *Camelidæ* and other ruminants, or what Kowalevsky has called the "adaptive type." This author has seen in the genus *Gelocus*, Aym., from the lowest Miocene or upper Eocene of France, the oldest ruminant, and the probable ancestor of a number of the types of the order, but among these he does not include the *Camelidæ*. The present genus as a more generalized type than *Gelocus*, in its separate trapezoid and distinct metacarpals represents an early stage in the developmental history of that genus. It also presents affinity to an earlier type than the *Tragulidæ*, which sometimes have the divided metacarpals, but the trapezoides and magnum co-ossified. In fact *Poëbrotherium* as direct ancestor of the camels, indicates that the existing *Ruminantia* were derived from these lines represented by the genera *Gelocus* for the typical forms, *Poëbrotherium* for the camels, and *Hyaemoschus* for the *Tragulidæ*. The first of these genera cannot have been derived from the second on account of the cameloid cervical vertebræ of the latter, and all three must be traced to the source whence were derived also the *Anoplotheriidæ*, perhaps the little known *Dichodontidæ*.

The two distinct metacarpals, separate trapezium and trapezoides, cameloid cervical vertebræ and dentition, characterize this type as a peculiar family which may be called *Poëbrotheriidæ*. The genus from which it takes its name was originally referred by Leidy to the *Camelidæ*. Allied genera are *Hypertragulus* Cope, *Leptomeryx* Leidy, and *Hypisodus* Cope, but there is good reason to believe that most or all of these genera are true ruminants, having the two metacarpals co-ossified, and the cuboid and navicular bones more or less completely united. Their cutting premolar teeth and foot structure refer them to the *Tragulidæ*, if the cervical vertebræ are not cameloid.

HYPISODUS MINIMUS Cope; *Leptauchenia minima* Cope, Pal. Bulletin, No. 16, p. 8; *Hypisodus ringens* Cope, Synopsis New Vertebrata, Colorado, p. 7.

This exceedingly small ruminant was very abundant during the period of the Oreodons, &c. I cannot discover any characters in the portions of dentition, (all except the superior P. M. 1 and 2,) at my disposal, by which to distinguish it from *Poëbrotherium*, although such may exist. The incisors, canine, and first premolar form an uninterrupted series of ten simple teeth at the symphysis.

This genus should doubtless be referred to the same group as *Leptomeryx*, *Hypertragulus*, etc.

HYPERTRAGULUS CALCARATUS Cope, gen. nov. *Leptauchenia calcarata* Cope, Pal. Bulletin, No. 16, p. 7.

This genus is allied to *Dremotherium* Geoffr., and *Leptomeryx* Leidy. The diagnoses may be thus compared; that of the first I derive from Pomel.

Hypertragulus Cope. Molars 6–6; first superior premolar without internal lobe; inferior premolars differing in form, the first one lobed, situated at a distance from the second, which is sectorial and not three-lobed.

Dremotherium Geoff. Molars 6–6; first superior premolar without interior lobe; inferior premolars similar, three-lobed and contiguous.

Leptomeryx Leidy. Molars 6–6; first and second superior premolars three-lobed, and with an internal lobe, third with an inner and an outer crescent. Inferior premolars similar, three-lobed and contiguous.

In *Hypertragulus* the third upper premolar exhibits an internal as well

as an external crescent. The canine of the inferior series stands in the middle of a considerable diastema, which is preceded by three incisors.

Char. specif.—The second superior premolar is quite short, and its inner lobe small. The last premolar has a strong cingulum on the anterior and especially on the posterior faces of the last premolar. The superior molars have no rib nor column opposite the interval between the crescents; the last molar exhibits four ribs on the outer side. The second (third) inferior premolar is compressed and elevated and much shorter than the third, which is three-lobed. The posterior crescents of the last inferior molar are opposite and not separated posteriorly by a fissure.

This very abundant species of musk is a little smaller than the *Leptomeryx evansii.*

HYPERTRAGULUS TRICOSTATUS, sp. nov.

Represented by the superior molars of one individual, and, perhaps, by numerous mandibles, which I cannot certainly associate with them. The last premolar has, as in the preceding species, a strong posterior cingulum, but there are only three ribs on the outer side of the third molar, the characteristic heel being absent. The latter also lacks the cingulum which passes round inner side of the bases of the crowns in *C. calcaratus*, its representative being the basal tubercle between the inner lobes of that and the other molars.

LEPTOMERYX EVANSII Leidy, Anc. Fauna Dak., Nebr., p. 165; *Trimerodus cedrensis* Cope, Pal. Bullet., No. 16, p. 8.

The form of premolars characteristic of *Trimerodus*, as cited, pertains also to this genus. The species represents the smaller forms, but I find a considerable range in size in the numerous specimens obtained, and do not, at present, regard them as belonging to more than one species.

ISCHYROMYS TYPUS Leidy, *I. chrysodon* Cope, Synopsis Vert. Col., 1873, p. 2; *Colotaxis cristatus* Cope, Pal. Bull., 15, p. 1.

This species varies considerably in the form of the premolar teeth, and I believe the above names refer to varieties, not species.

ELOTHERIUM RAMOSUM Cope, sp. nov.

Established on the greater part of a mandible, with teeth from a cranium which, when complete, must have measured nearly two feet and a half in length, indicating an animal not smaller than the largest living rhinoceroses. The species is remarkable for the great size of the tubercles on the under side of the mandibular ramus, especially the anterior pair. The symphysis is narrow, and the tuberosities form two branches, whose bases occupy the entire lower part of its anterior face. They are several inches long, and directed outward and downward. The posterior edge is acute, and the extremity very rugose, as though for the attachment of a horny cap. The outer face is flat, the inner convex. The second tuberosity is below the first true molar, is flat and turned outward, with apex obtuse in profile. The molar teeth number seven; the first and second of the four premolars are separated by a diastema, and have but a single root. The tubercles of the molars are low; the crowns of some of the premolars have a cingulum in front and behind. The canines are lost, but their alveoli indicate huge size; the root possesses an open groove on the front of the inner side. The outer incisors large; the last molar two-lobed and rather small.

Measurements.

	M.
Length of series of inferior molars	0.370
Long diameter of canine alveolus (28.5 lines)	.060
Length of true molar series	.140
Length of crown of fourth premolar	.053
Height of crown of fourth premolar, (worn)	.022
Width symphysis between canines	.090
Length of chin process, (3.5 inches)	.090
Width anteroposteriorly	.080
Length of interval to the second tuberosity	.150
Length of basis of the second tuberosity	.075

The only species which it is necessary to compare with the *E. ramosum*, in respect to size, is the *E. imperator* Leidy, (*E. superbum* Leidy, an older but less appropriate name,) known from a few teeth (none molars) from California and Oregon. The long diameter of the canine is to that of *E. ramosum* as $5\frac{1}{2}$ to $7\frac{7}{8}$.

SYMBORODON TRIGONOCERAS Cope. Synopsis of New Vertebrata, Colorado, 1873, p. 13.

This species has recently been described by Prof. O. C. Marsh under the name of *Brontotherium ingens*, and a cranium figured, in the American Journal of Science and Art, 1874, p. 85. The advance copies bear date December 30, and are therefore subsequent to the issue of the "Synopsis" above cited, which took place on October 16. Several crania in my possession agree with the one figured by Professor Marsh. A large proportion of the characters mentioned in his paper as characteristic of the species and genus will be found in the Synopsis, p. 14, and in the Paleontological Bulletin, No. 15, pp. 3–5; and the ascription of a proboscis to the genus in the "Independent" (New York) for October 30, 1873. Professor Marsh states that the genus *Symborodon* Cope is not distinct from *Brontotherium* Marsh. The latter was described by him as possessing four inferior incisors; in *Symborodon* there are no inferior incisors whatever. This I have verified on perhaps a dozen mandibles of several species. I have not identified any as certainly belonging to this one; so that if it possesses incisor teeth, as stated by Professor Marsh, it should be called *Brontotherium trigonoceras.*

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DEPARTMENT OF THE INTERIOR.

BULLETIN

OF

THE UNITED STATES

GEOLOGICAL AND GEOGRAPHICAL SURVEY

OF

THE TERRITORIES.

No. 2.

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1874

DEPARTMENT OF THE INTERIOR.

BULLETIN

OF THE

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

No. 2.

April 9, 1874.

PREFATORY NOTE.

Now that two numbers of the Bulletin have been issued by the Survey, a word of explanation as to the object of its publication seems to be necessary. The vast amount of new material in all departments of natural history collected in the West under the auspices of the Survey, and in some instance demanding prompt publication, suggested the present form, in order that this new matter might not be too much scattered, either in the proceedings of societies, or in independent papers not easily accessible to the scientific student. The annual report will not appear until late in the summer, (July or August,) and, in consequence, the Bulletin will be issued from time to time as the necessity arises for the prompt publication of valuable matter.

The article by Professor Cope in the present number of the Bulletin is one of no ordinary value. While I dissent from some of his views, I regard his researches as having a direct bearing on the solution of the problem to which I have repeatedly called the attention of geologists in my annual reports as the most important one in the geology of the western portion of our continent, viz: The relations of the Cretaceous and Tertiary periods to each other. I have always expressed my belief in the continuity of all the great formations from the Silurian to the present time, and that the highest privilege of the geologist is to discover the evidence that bridges over all chasms and obliterates all the lines of demarkation. When our knowledge of the geological history of the world is more complete, we may expect to find well-marked beds of passage or transition between all the great groups of the geological scale. Hitherto, the chasm between the Cretaceous and the Tertiary periods has been very marked; but the evidence now so rapidly accumulating points to the conclusion that this, too, will be bridged over. The solution of this problem has also a most intimate connection with the physical growth and history of the western portion of our continent. One of the principal objects of the survey for years has been, to collect all the evidence bearing on this subject that could be secured, and, with this thought in view, I have requested Professors Leidy and Cope to approach the problem through the extinct vertebrate fauna, Mr. Lesquereux through the fossil flora, and Mr. F. B. Meek through the study of the invertebrata. The differences of opinion as to the age of the formations under discussion have been very great.

Up to within a comparatively recent date I have regarded the entire Lignitic group of the West as of Tertiary age. My own explorations began at an early period (1853) in the Northwest, along the Missouri River and its tributaries. There, the Lignite group is largely developed, and is even at this time supposed by some of our best geologists and paleontologists to be of Middle Tertiary age. This group in the Northwest indicates a brackish-water deposit at the base, but is mostly of purely fresh-water origin. I traced this group, without interruption, from latitude 49° north, along the east base of the Rocky Mountains southward, to a point near Laramie Peak, latitude 43°, where it is overlapped by the White River deposits for a distance of about two hundred miles. The lignitic beds rise again to the surface about fifteen miles south of the Union Pacific Railroad. A very narrow range of mountains separates this group from the Laramie Plains, and prior to the elevation of the mountains, no doubt, the surface-continuity was unbroken. During the summer of 1868 I made a careful examination of the coal-beds at Bear River Station and Coalville, Utah, and there I found the first proof that I had

detected that the lignitic group extended down into undoubted Cretaceous beds. My statement at that time has been overlooked, and I here beg permission to call attention to it. In a paper published in the Proceedings of the American Philosophical Society of Philadelphia, dated February 19, 1869, page 48, will be found the following paragraph:

"Near Coalville, a little town in the valley of Weber River, five miles above the mouth of Echo Creek, coal outcrops several times. At Sprigg's opening, the dip is 20° or 30° east; and the coal-bed is about fifteen feet thick, capped with gray sandstone, much of it charged with pebbles. I was informed that in other places this pebbly sandstone rests directly on the coal-bed. A few hundred feet from Sprigg's opening, a shaft to strike the same bed has been sunk seventy-nine feet deep, through twelve feet of gravel and sand, into black clay, that grows harder downward, and contains numerous specimens of a species of *Inoceramus*, *Ostrea*, and *Ammonites*, showing that the black clays are certainly of Cretaceous age. If these beds do actually lie above the coal, as the dip would indicate, then this formation, of doubtful age, extending from Quaking Asp Summit to Salt Lake, must be Cretaceous, and some of the finest coal-beds in the West are in rocks of that age."

At Bear River City I found, in considerable numbers, *Inoceramus*, *Ostrea*, and other marine forms of mollusks above the principal coal-bed, which is nearly vertical in position; but neither at Bear River City nor at Coalville have I ever known of any plants being detected below the lowest coal-bed. At Evanston, about twelve miles west of Bear River City, the thickest bed of coal in the West is found, and above and below it I found, in 1871, a great number of species of plants, many of which have an extended vertical as well as horizontal range in the lignitic group. It is plain, therefore, that the coal at Evanston is of more modern age than that of the Bear River group, as shown at Bear River City and Coalville, Utah. As we go southward into Southern Utah, New Mexico, and Arizona, the greater portion of the coal-beds are in rocks of undoubted Cretaceous age. It seems conclusive, therefore, that the lignitic group began in the Cretaceous period in the marine seas and continued on upward, through the brackish-water times, into the purely fresh-water deposits.

The illustrated volumes on the paleontology of these formations, which will probably appear within a year, will doubtless define with greater precision the various divisions of the Cretaceous and Tertiary groups, and settle the vexed questions of age. The very elaborate and important volume, by Mr. F. B. Meek, on the invertebrate fossils, will be ready for the press the coming summer. The plates are now engraved. The memoir of Lesquereux on the flora of the Dakota group with twenty-eight plates is now ready, and he is now at work on the Tertiary flora. All the other volumes are in an advanced state of preparation.

I would call attention to the very important article in this number of the Bulletin by Professor Lesquereux on the extinct flora of the Dakota group; also the article on the new species of orthoptera, by Professor Thomas, and the interesting notes on the mountain-ranges of Colorado, by Mr. Gardner. The elevations of the mountain-peaks, which occur in the various districts surveyed by the party during the past summer, will prove of great practical value.

In Bulletin No. 1 I inadvertently omitted to include the names of Robert Adams, jr., assistant quartermaster, and Mr. C. Adams, among the members of the corps for 1873.

F. V. HAYDEN,
United States Geologist.

PHILADELPHIA, *February* 1, 1874.

SIR: Please find accompanying a catalogue of the species of *vertebrata* whose remains are known to occur in the various formations of the cretaceous period west of the Mississippi River. I preface it with a few notes on the stratigraphy of the upper beds, mostly taken while attached to the United States Geological Survey during the summer of 1872. I desire to express my indebtedness for the loan of much valuable material used in the present investigation to Professor B. F. Mudge, of Manhattan, Kansas; also to Dr. John H. Janeway, post-surgeon at Fort Hays; to Professor Merrill, of Topeka, and to Messrs. Weltman and Henry Swigart, of Evanston, Wyoming.

I am, with best wishes,

EDWARD D. COPE,
Paleontologist.

Dr. F. V. HAYDEN,
Director of the United States Geological Survey of the Territories.

REVIEW

OF

THE VERTEBRATA OF THE CRETACEOUS PERIOD FOUND WEST OF THE MISSISSIPPI RIVER.

BY EDWARD D. COPE, A. M.

SECTION 1.—ON THE MUTUAL RELATIONS OF THE CRETACEOUS AND TERTIARY FORMATIONS OF THE WEST.

The subject which it is proposed here briefly to discuss is one which has excited considerable interest for several reasons. One of these is, that there exists some discrepancy in the evidences as to the true age of beds at the summit of the Cretaceous period and base of the Tertiary in the Missouri and Rocky Mountain regions, and hence a difference of opinion. Another is, that the question of continuity in topographical, and hence of faunal and floral relations, will be largely elucidated by a proper determination of the beds in question, both geologically and paleontologically. I have endeavored to attain some results in the latter field in the department of vertebrata, which are here presented, with some stratigraphical observations made at localities either little or not previously studied.

Messrs. Meek and Hayden have classified the vast thickness of the Cretaceous system, recognizing five epochs as quite distinctly defined. These are as follows:

I. THE DAKOTA group, (No. 1.) The present list does not include any species as discovered in this formation. Developed on the Missouri, and on the Rio Grande, New Mexico.

II. THE BENTON group. Seen on the Missouri River by Hayden, and stated by him to extend to the Smoky Hill River, in Kansas, and to Texas. The present list includes only three species from it, namely: *Hyposaurus vebbii*, a crocodile; *Apsopelix sauriformis*, a clupeoid and *Pelecorapis varians*, a ctenoid fish. Other species of fishes occur in the same formation in Kansas.

III. THE NIOBRARA group. From the Missouri, Kansas, and Texas, according to Hayden. Confirmatory of the last locality are remains of *Pythonomorphor* from that State, discovered and sent to me by Dr. A. R. Roessler. I have also described a species of that order as common to Eastern New Mexico and Western Kansas; and Hayden and Seconti state that it appears north of the Arkansas in Southern Colorado. Vertebrate remains are abundant in this formation, and it has furnished a majority of those enumerated in the following catalogue. They are distributed as follows, among the orders of Vertebrata:

Aves—	
Natatores	2
? *Saururæ*	2

Reptilia—

Dinosauria	1
Pterosauria	4
Sauropterygia	3
Testudinata	3
Pythonomorpha	27

Pisces—

Isospondyli	31
Selachii	10

IV. THE PIERRE group; in Nebraska, and Dakota, and Middle Colorado, south of the divide between the waters of the Arkansas and Platte Rivers. Also the lower bed of Greensand of New Jersey. Besides the numerous remains of reptiles and fishes found in New Jersey, this formation contains saurian (mosasauroid) remains in Colorado. Weber River, Wyoming,* below the coal.

V. THE FOX HILLS group; extended in Central Dakota; on the Arkansas and tributaries in Southern Colorado; and as the second Greensand bed in New Jersey.†

VI. THE FORT UNION or Lignite group.

With this epoch we enter debatable ground, and begin to consider strata deposited in brackish or fresh waters, which were more or less inclosed by the elevation of parts of the Rocky Mountains and other Western regions, and which are therefore more interrupted in their outlines than the marine formations which underlie them. Dr. Hayden has recognized and located a number of formations of this character, to some of which he has applied the name of "transition beds." That the period of their deposit was one of transition from marine to lacustrine conditions is evident, and that a succession of conformities in position of beds may be traced from the lowest to the highest of them, and with the Tertiary strata above them at distinct localities, beginning at the south and extending to the north, is also proven by Hayden and others. It appears impossible, therefore, to draw the line satisfactorily without the aid of paleontology; but here, while evidence of interruption is clear, from the relations of the plants and vertebrate animals, it is not identical in the two cases, but discrepant. I therefore append a synopsis of the views expressed by authors, with a presentation of the evidence which is accessible in my department. I am aware that the combination I shall make is of a highly inflammable character, because it not only relates to the most combustible deposits of the West, but also to the "partie honteuse" of cotemporary geologists and paleontologists. But should any inflammation ensue, I hope it will be attributed to the nature of the materials employed, rather than to any inattention on the part of the author to the just claims of his friends.

Hayden has named the following as distinct epochs of transitional character, all of which he originally referred to the Tertiary period. I give them in the order of age which he has assigned to them.* (1.) Placer Mountain; locality, New Mexico. (2.) Cañon City coals, Southern Central Colorado. (3.) Fort Union, or Lignite group; Dakota, Montana, and Wyoming. (4.) The Bitter Creek series; embracing the Bitter Creek coals, Wyoming. (5.) Bear River group, Western Wyoming. To these may be added the Judith River beds, of Montana, which Dr. Hay-

* Hayden's Annual Report, 1870, p. 167.

†For a review of the extinct reptiles of this epoch, see the author's Extinct Batrachia Reptilia, etc., N. Am., 1870.

* Geological Survey of Colorado, 1869, p. 90.

den has placed with reservations below the Fort Union series, leaving their final location for future discoveries.

No vertebrate remains having come under the author's notice from the Placer Mountain and Cañon City formations, no further notice can be here taken of them beyond the statement that they are as Meek indicates of Cretaceous age, not far removed from the horizon of the coals of Weber River, Utah. The presence of ammonites and baculites above and below them has indicated such a conclusion to Leconte*, as it has in the case of the Weber River beds to Dr. Hayden.† To near the same horizon is perhaps to be referred the coal observed by Prof. Marsh‡ on the south side of the Uinta Mountains in Utah, which were overlaid by strata containing *Ostrea congesta.* This may, indeed, be referred to a still older period, as that oyster is characteristic of No. 3, according to Meek and Hayden. The Placer Mountain and Cañon City groups are nearer to No. 5, but the precise relation to it has not yet been determined. I therefore proceed to the Fort Union group as No. vi.

This extended deposit is stated by Hayden§ to extend from the Missouri Valley to Colorado, passing under Tertiary beds by the way. That this is the case has been confirmed by the researches conducted in the northern and eastern portions of Colorado during the season of 1873 by the writer.|| I present comparative lists of the vertebrate species known from the Platte and Missouri Valleys in the respective Territories:

COLORADO.	DAKOTA.
Compsemys victus,	*Compsemys victus,*
Adocus lineolatus,	*Adocus lineolatus,*
Plastomenus punctulatus,	*Plastomenus punctulatus,*
Plastomenus insignis,	* *
Trionyx vagans,	*Trionyx vagans,*
* *	*Ischyrosaurus antiquus,*
* *	*Plesiosaurus occiduus.*
Bottosaurus perrugosus,	* *
Polyonax mortuarius,	* *
Cionodon arctatus,	* *
Hadrosaurus occidentalis,	*Hadrosaurus occidentalis.*

The identity and correspondence of the species indicate that these remote localities contain the remains of the same fauna. Further, the presence of the orders *Sauropterygia* and *Dinosauria* establishes conclusively the Cretaceous and Mesozoic character of that fauna.* This reference was made by the writer in 1869, and was at that time opposed to the views extant, both geological and paleontological. The following exhibits the state of opinion on this point at that time:

1856. Meek and Hayden, Proceedings Academy Philadelphia, p. 63, referred them to the Tertiary.

1856. Meek and Hayden, l. c., p. 255; Lignite referred to the Miocene.

1856. Meek and Hayden, l. c., 113; referred to Lower Tertiary.

1856. Leidy, l. c., p. 312. *Thespesius occidentalis, (Hadrosaurus ;)* referred to the Mammalia and regarded as perhaps Dinosaurian.

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*Report on the Geology of the Smoky Hill Pacific Railroad Route, 1868, p. 66.

†Annual Report, 1870, p. 168.

‡ See an interesting article by Prof. O. C. Marsh on the Geology of the Eastern Uintah Mountains; Amer. Jour. Sci. Arts., March, 1871.

§Annual Report, Colorado, 1869, p. 89.

||See Bulletin of the United States Geological Survey, 1874, p. 10.

* Two species are provisionally referred to the Tertiary genus *Plastomenus*, but are too fragmentary for final determination.

1856. Leidy, l. c., 1856, p. 89; *Ischyrosaurus* referred to the Mammalia as a *Sirenian*.

1860. Hayden, Transac. American Philosoph. Society; repeats former conclusions, and Leidy refers *Thespesius* more decidedly to the Sauria.

1868. Hayden, Amer. Journal Science Arts, 1868, p. 204; Lignites regarded as Tertiary, from both vegetable *and animal remains* from the Missouri and the Laramie plains.

1868. Leconte, Exploration of the Smoky Hill R. R. Route, p. 65; the Colorado beds are "older than those of the Missouri or Great Lignite bed of Hayden, which are probably Miocene," &c.

1869. Cope, Trans. Amer. Philos. Soc., pp. 40, 98, 243; supposed mammalian remains proven to be reptilian, and the formation referred to the Cretaceous.

1871. Newberry, in Hayden's Annual Report, pp. 95, 96; Lignite flora regarded as Miocene.

1874. Cope, loc. supra cit., Lignite of Northern Colorado referred to the same horizon.

The Judith River beds may be noticed in this connection. They have yielded but few vertebrate remains, namely, six species of Reptilia. Four of these are Dinosauria, and hence diagnostic of the Mesozoic age of the formation. The presence of a species, *Hadrosaurus mirabilis* Leidy, closely allied generically and *specifically* to a species *(H. foulkei)* of Cretaceous Nos. 4 and 5 of New Jersey, induces me to believe that the formation is Cretaceous, and such would appear to have been the suspicion of Messrs. Meek and Hayden when they originally described the deposit and its invertebrate fossils. Leidy suspected that the species "indicate the existence of a formation like that of the *Wealden* in Europe."* Meek and Hayden† remarked, "We are inclined to think with Prof. Leidy that there may be at the base of the Cretaceous system a fresh-water formation like the *Wealden*. Inasmuch, however, as there are some outliers of fresh-water Tertiary in these lowlands, we would suggest that it is barely possible these remains may belong to that epoch." From the stand-point of the writer, these beds would be at the top of the Cretaceous, and more or less related to the Fort Union epoch. Mr. Meek expresses himself* cautiously with reference to the age of the Fort Union and Judith River formations, as follows: "The occurrence of" fossils specified "at the Judith River localities would certainly strongly favor the conclusion not only that this Judith formation, the age of which has so long been in doubt, is also Cretaceous; but that even the higher fresh-water Lignite formation at Fort Clark and other Upper Missouri localities may also be Upper Cretaceous instead of Lower Tertiary. That the Judith River beds may be Cretaceous, I am, in the light of all now known of this region of the continent, rather inclined to believe. But it would take very strong evidence to convince me that the higher fresh-water Lignite series of the Upper Missouri is more ancient than the Lower Eocene. That they are not is certainly strongly indicated not only by the modern affinities of their molluscan remains, but also by the state of preservation of the latter," &c. It is thus evident that the paleontologists as well as stratigraphers have continued to regard the Lignite series as Eocene and not Cretaceous, as is and has been maintained by the writer since 1868.

VII. THE BITTER CREEK SERIES, mentioned by the writer as a distinct group in the proceedings of the American Philosophical Society,

*Proceedings Academy Philadelphia, 1856, p. 73.
†L. c. 1856, p. 114.
*Hayden's Annual Report, 1872, p. 450.

1872, (published on August 12,) is apparently regarded by Mr. Meek also as representing a distinct epoch.‡ He says: "The invertebrate fossils yet known from this formation are in their specific relations, with possibly two or three exceptions, new to science and different from those yet found either at Bear River, Coalville, or indeed elsewhere in any established horizon, so that we can scarcely more than conjecture from their specific affinities to known forms as to the probable age of the rocks in which we find them." On this account, and because of the great stratigraphical differences exhibited by the Bear River and Evanston coal strata, I have followed Hayden in regarding the Bear River group on the west side of the Bridger Basin as representing a distinct series of rocks, with present knowledge. On this account I omit, as heretofore, allusion to determinations of age of the latter formation as irrelevant in discussing the age of the Bitter Creek epoch.*

My own observations on the relations of these rocks, made during the summer of 1872, have been in measure anticipated by the detailed reports of Messrs. Meek and Bannister, † which, with the older observations of Dr. Hayden and Mr. Emmons, (of King's survey,) leave little to be added. However, as none of these gentlemen paid especial attention to the vertebrate paleontology, the bearing of this department in relation to the stratigraphy remains to be explained.

As Dr. Hayden remarks, the Union Pacific Railroad, at Black Butte Station, passes through a monoclinal valley, the rocks on both sides having a gentle dip to the southeast. This dip continues to the eastward to near Creston, where the beds pass under the newer tertiary strata. Following the railroad westward from Black Butte, the same dip continues to near Salt Wells, where we cross an anticlinal axis, the dip of the strata being gentle to the northwest. There are minor variations in the dip, but the general result is as stated. They disappear five miles east of Rock Spring Station, beneath the latter beds of the Green River Tertiary, which at this point presents a line of strike, extending northeast and southwest across the railroad in the form of a range of bluffs of considerable elevation. They are composed of lighter colored and softer material than the Bitter Creek strata. The latter consists of alternating beds of hard and soft sandstone, with argillaceous and carbonaceous strata. The upper part of the series contains eleven coal-strata; at Rock Spring I was informed that the upper was ten feet in thickness, and the next four feet. Returning eastward, the heavier bedded sandstone is low in the series at Point of Rocks, in consequence of the southeast dip; and the upper beds are softer and abound in fossil shells. At Black Butte Station, the heavy sandstone bed disappears from view toward the east, and the eleven coal-strata appear above it. About twenty feet above the sandstone, between two of the thinner beds of coal, the bones of the *Agathaumas sylvestris* were found embedded in leaves and sticks of dicotyledonous plants, cemented together by sand and clay. Where the heavy sandstone bed disappears below the level of the track of the railroad, in the course of its eastern dip, a thin bed of coal just above it soon follows; then a bed of shells containing oysters, more and less numerous at different points, may be traced for some distance before it also disappears. Near the latter point

‡Hayden's Annual Report, 1872, pages 459, 461, published April, 1873.

* This course has been misunderstood by Mr. Meek and others as implying a design to ignore those determinations. Both Mr. Emmons and Mr. Meek are clear in the expression of their conclusions as to the age of the Bear River epoch.

† See Hayden's Annual Report, 1872, pp. 457, 525.

a bed of melanians and other fresh-water shells is seen a few feet above them.

A section, carried for eight miles south of Black Butte Station, exhibits the relation of the Bitter Creek series to the superincumbent Tertiaries very instructively. The whole series rises slightly to the southward, and more distinctly to the westward, so as to form an escarpment as the eastern border of an open valley, which extends south from the railroad, just west of the station. The heavy bed of sand-rock is here as elsewhere the land mark and stratigraphical base-line. Moving south from the railroad, we keep along the strike of the lower coal-beds. Just above the sandstone bed the softer stratum thickens, and six miles from the station is covered with the *débris* of immense numbers of *Leptesthes crassatelliformis*. Passing over the edges of the strata toward the southeast, I counted eight beds of coal separated by various short intervals, the eighth being the heaviest, and five or six feet thick. Above this one three thin beds of lignite were crossed in succession, each accompanied with an abundance of leaves of chiefly dicotyledonous plants. Then came the ninth bed of coal, and then in order three more beds of lignite, with abundant leaves. During this time the ascent became less steep, and a number of level tracts were passed before reaching the upper bed of lignite. Beyond this I passed another short flat which was marked by a number of worn banks of the light ash color that distinguishes the material of the bluffs of the Green River Tertiary which overlie the coal series near Rock Springs. I had not ridden a quarter of a mile before reaching a low line from which one of my men picked up a jaw of a small mammalian allied to the Bridger *Hyopsodus* or *Hyracotherium* of the Eocene of France and Switzerland, and a number of Paludina like shells. I had thus reached the summit of the Bitter Creek formation, which did not appear to be much more than three hundred and fifty feet above its base at the railroad. In full view, a mile or two to the south, rose the first of the benches which constitute the levels of the Green River formation. Between this and the first mammal-producing bed rose three banks, one beyond the other, measuring altogether one hundred and twenty feet; perhaps the lowest was ten feet above the first bank, and this one not more elevated above the last lignite and leaf bed. In all of these I found bones of Green River vertabratæ exceedingly abundant, but all dislocated and scattered, so as to be rarely in juxtaposition. These consisted of the following species:

FISHES, *Clastes (?) glaber.*
REPTILES, *Emys meganlax.*
Emys pachylomus.
Emys enthovetus.
Trionyx scutumantiquum.
Alligator heteorodon.

MAMMALS, *Orotherium vasacciense*, and fragments of others too imperfect for determination.

In the third bank, in immediate juxtaposition with the remains just enumerated, I found another thin bed of lignite, but this time without any visible leaves. In a fourth line of low bluffs, a little beyond, I found that remarkable mammal *Metalophodon armatus*, with its dentition nearly complete, in connection with fragments of other mammals and reptiles.

Behind these rises the first line of white bluffs, already described, which extends away to the east; to the west it soon terminate in a high escarpment, in north and south line with that of the Bitter Creek

beds, already mentioned as bounding a north and south valley. This and the superjacent strata, which we pass over in going south, *appear* to be conformable to those of the Bitter Creek series beneath them. I say "appear," for slight differences of dip are not readily measured by the eye; yet I suspect that the conformability is very close, if not exact, and similar to that mentioned by Meek and Bannister as exhibited by the beds of the Washakie group, which lie upon the coal series east of Creston. The white bluffs add perhaps one hundred feet to the elevation. On their summit is a thin bed of buff clay and sand rock, similar to the upper strata of the Bitter Creek series, and containing numerous shells, and some scattered teeth and scales of fishes. I called Mr. Meek's attention to the specimens of these shells, which I sent him, and his reply was that most were of identical species with those of the coal series, cretaceous, and that they presented no general peculiarity.

At a short distance to the southward another line of white bluffs extends across the line of travel. This is not more elevated than the preceding one; I only found remains of tortoises on it. Several miles to the south we reach another bench, whose bluffy face rises four or five hundred feet in buttress-like masses, interrupted at regular intervals by narrow terraces. This line is distinguished for its brilliantly-colored strata extending in horizontal bands along the escarpment. They are brilliant cherry-red, white, true purple with a bloom shade, yellow, and pea-green, forming one of the most beautiful displays I ever beheld. The lower portions are bright red, which color predominates toward the West where the bluffs descend to a lower elevation. I found on them remains of a turtle (*Emy enthnetus* Cope,) and some borings of a worm in a hard layer. On top of these are clay and slate rocks of a muddy yellow color with their various ledges rising to perhaps two hundred feet. Continuing now to the southeastward along the old stage-road, we cross South Bitter Creek at the old Laclede Station. Some miles south and east of this point we cross a band of buff sand-stones, forming a bluff of fifty or more feet in elevation. Below it lie more white or ashen beds, which contain remains of mammals and turtles rather decayed. A short distance beyond these, and forty miles from Black Butte Station, we reach the base of the enormous pile of sediment which I have called the Mammoth Buttes. These form a horseshoe-shaped mass, the concavity presenting south and eastwardly, the summit narrow, serrate and most elevated to the east, and descending and widening toward the south. I estimated the height of the eastern end to be at least one thousand feet above the plain surrounding it. Numerous mammalian remains* demonstrated that this mass is a part of the Bridger Eocene, although as Mr. Emmons, of King's survey, informs me, no continuous connection with the principal area west of Green River can be traced. The total thickness of the Green River and Bridger formations on this section cannot be far from twenty-five hundred feet at a very rough estimate.

The point of transition from the Cretaceous to the Tertiary deposits, as indicated by the vertebrate remains, is then in the interval between the last plant-bed at the summit of the buff mud rocks, and the mammal bone deposit in the lowest of the ash-gray beds. Below this line the formation must be accounted as Cretaceous, on account of the presence of the Dinosaurian *Agathaumas sylvestris;* and those above it, as I

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* See The Monster of Mammoth Buttes, Penn Monthly Magazine, 1873, August.

* On *Bathmodon*, an extinct genus of Ungulates, Feb. 16, 1872. Hayden's Annual Report, 1870, p. 431; Annual Report, 1872, p. 645.

have already pointed out, Eocene,* on account of the types of mammalia contained in them.

The authorities on the Bitter Creek formation have presented views more or less at variance with those entertained by the writer, or of such dubious character as to fall very far short of the requirements of evidence. Dr. Hayden has regarded them as Tertiary and as transitional from Cretaceous to Tertiary. Mr. King, in his very full article on the Green River Basin, definitely refers the lower part of the series to the Cretaceous, in the following language:† "We have, then, here the uppermost members of the Cretaceous series laid down in the period of the oceanic sway, and quite freely charged with the fossil relics of marine life; then an uninterrupted passage of conformable beds through the brackish period up till the whole Green River Basin became a single sheet of fresh water." He regards the line of the upper bed of oysters as the summit of the Cretaceous, and the superimposed beds as Tertiary, in the following language, (page 453:) "while the fresh-water species, which are found in connection with the uppermost coal-beds, seem to belong to the early Tertiary period." He thus places the line some distance within what I have regarded as the Cretaceous boundary; what the significance of this conclusion is will be subsequently considered.

Mr. Lesquereux, as is known, regards these beds as Tertiary, not only on account of their vegetable fossils but also on account of the stratigraphic relations of the formation. His conclusion to this effect is consistent throughout, and is a fact of the highest importance in this connection.

Mr. Meek has fully discussed the age of this series in his interesting article in Hayden's Annual Report for 1872, the general tenor of which is indicated by the passage I have quoted from the opening of his remarks in the beginning of the present notice of the Bitter Creek beds. His opinions may be cited as follows: In the Annual Report for 1870, he determined the beds visible at Hallville as Tertiary; in that of 1871 three species of oysters from other parts of the Bitter Creek beds are placed in the Cretaceous list, each one with question as the identification of species, a point, it is to be noticed, equivalent in the case of oysters to question of the age of deposit. The remarks in his report, as well as those in Mr. King's report, refer either to the much lower Weber River coal or to the different area of the Bear River group, and are consequently noticed under that head.

In a paper on the age of these beds, published August 12, 1872, the writer asserted the Cretaceous age of the series. On this Dr. Bannister, the companion of Mr. Meek, writes* that "Mr. Meek, and, I believe, Mr. Emmons also, had considered that these beds might be Cretaceous, but this was rather on account of the change in the fossil fauna from purely fresh water, as in the characteristic Tertiary of this region, to brackish water marine, and the specific affinities of a few of the fossils to California Cretaceous species, than from any very positive evidence. As far as I know, the only evidence of this kind is the identification by Prof. Cope of the Saurian remains found by us at Black Butte."

It only remains to observe that the strata and coal of the Bitter Creek group of the Cretaceous are either wanting on the western and southern borders of the Green River Basin, or are concealed by the superincumbent Tertiaries. Instead of these, a comparatively thin bed of apparently unfossiliferous quartzite or sandstone lies at a high angle against

†Exploration of the 40th parallel, p. 458.
*Annual Report, 1872, 534.

the bases of the Uinta* and Ham's Fork Mountains respectively, on beds of Jurassic age, which are probably Cretaceous No. 1, (Dakota.) The beds observed by Prof. Marsh on the south side of the Uinta Mountains, on Brush Creek, belong neither to the Dakota nor Bitter Creek epochs, but perhaps to No. 3, if, as Prof. Marsh asserts, the oyster found in a superjacent stratum is *Ostrea congesta*, Con.; it is in any case of no later date than the Cañon City or Weber River coals. Hence the assumption of some writers that this discovery determined the age of the Bitter Creek series to be Cretaceous is without foundation in fact.

VIII. THE BEAR RIVER GROUP of Hayden occupies, according to him, a distinct basin, to the west of an anticlinal axis which separates it from that of Green River. It is buried under Tertiary beds, the age of which has been a question of interest, and will be hereafter considered. In order to determine the relations of the two basins, a section was carried across the rim of the eastern, starting from the Fontanelle Creek, eighty miles north of the Union Pacific Railroad, and continuing toward the upper waters of Ham's Fork of the Green River to the westward. My notes are as follows:

The beds of the Green River epoch dip gently from the point where my last notes left them near the Rock Spring Station, toward the northwest all the way to Green River. The upper strata becomes slaty in character, and descends to the water-level at the river, where they form a high bluff. In these slates occur the fish-beds discovered by Dr. Hayden, as well as the insect-beds noticed by Messrs. Denton and Richardson. They are worn into towers and other picturesque forms at Green River City. (See Hayden, Annual Report, 1870.) Passing north from the railroad, up the valley of Green River, the slates display a gentle dip to the north, and eighteen miles beyond have disappeared from view. On both sides of the river huge mesas of the Bridger formation come into view, those on the east extending to the Big Sandy River, and those on the West to Ham's Fork. At Slate Creek, farther to the north twenty miles, a yellowish-brown sandstone rises into view, and continues to increase in importance toward the north. At the mouth of Fontanelle Creek it rises on the east side of the river to a height of perhaps two hundred and fifty feet; but sinks toward the north and east from near the mouth of Labarge Creek, fifteen miles up the river. North of Labarge a similar bed of sandstone rises again, and is immediately overlaid by white shales resembling those of the Green River epoch, which have here a great thickness. Opposite the mouth of the Labarge their lower strata are bright-red, but on the west side of the river the sandstone only is visible. All the beds rise to the north, the red beds forming the summits of the cliffs in that direction.

In passing up Fontanelle Creek to the westward, the heavy beds of buff sandstone gradually descend, and the white shales come into view. I examined the former for lignite and coal, but found none. There are several thin beds of a tough carbonaceous material in the white shales, (which I take to be of the Green River epoch.) In the lower strata, in this locality as well as on the east side of Green River, above the mouth of Labarge Creek, are numerous remains of fishes similar to those of Green River City, with insects and their larvæ, shells like Pupa and Cyrena, and millions of Cypris. The larvæ are dipterous, some nearly an inch long, and others minute, and in prodigious numbers. With them are found stems of plants, but no leaves. These beds rise with a

* See Hayden's Annual Report, 1870. Marsh, American Journal of Science and Arts, March, 1871.

very gentle dip, and twenty miles from the mouth of the creek terminate against steeply-inclined strata of earlier age. At this point the lower beds exhibit the bright-red colors that are so often seen in the lower parts of the formation at other points. The uplifted beds form a ridge of high hills having a N. by E. and S. by W. trend, through which the Fontanelle cuts its way in a deep cañon. This range is monoclinal, the strata dipping 45° E. and their outcrop on the summit and eastern face. The first bed which forms the surface of the incline is rather thin, and is composed of a reddish quartzite without fossils, no doubt of Cretaceous age. Below it is a stratum of highly fossiliferous bluish limestone of Jurassic age, containing *Pentacrinus asteriscus* M. and H., *Trigonia*, etc. Below this a reddish sandstone presented a similar thickness, which may represent the trias, which rests on a bluish shale formation. We have now reached the base of the western side of the hills; from their summit we have had a beautiful and interesting view of geological structure. The valley, of three or four miles in width, is bounded on the west side by a range of low mountains, whose summits are well timbered. The valley is excavated at an acute angle to the strike of the strata, so that as far as the eye can reach to north and south successive hog-backs issue *en echelon* from the western side and run diagonally, striking the eastern side many miles to the southward. At the cañon of the Fontanelle six of these hog-backs occupy the valley, and the number varies as we proceed down the valley. The structure changes from the same cause, as we explore in either direction. The dip of all these hog-back strata is to the west and slightly north, less steep at the eastern side, but reaching 45° and a still higher angle at the middle and west side of the valley. There appears to be an anticlinal near the base of the eastern range, which has been deeply excavated; from its western slope (in the valley) the upper beds, even in the eastern range, have been carried away, leaving only probable Triassic and carboniferous strata exposed. In one of these latter I found a well-marked horizon of carbonaceous shales extending as far as I explored them. Toward the western side of the valley the descending strata are sandstones, but whether identical with that of the eastern hills of Cretaceous age I could not ascertain. Lower down the valley (to the south) similar beds form a high vertical wall of very light color, the scenery resembling that of the Garden of the Gods in Colorado. I suspect that the existence of more than one fold can be demonstrated in these hog-backs and mountains.

The result which bears on the history of the Bear River group is, that on this side of the Green River Basin the Bitter Creek epoch is either wanting or represented by a thin layer of red quartzite, (or perhaps Cretaceous No. 1,) and that no coal of cretaceous age exists along its western rim. After following the valley to Ham's Fork River, and proceeding a short distance along it toward the southeast, I crossed a thin bed of coal in the upturned edges of the same beds crossed in the valley above. The discovery of the extension of the fish and insect bed sixty miles north of the principal localities is a point of interest in Tertiary geology.

The Ham's Fork Mountains form the divide between the waters of Green and Bear Rivers respectively, and is passed by the Union Pacific Railroad at and west of Aspen Station, as is described by Dr. Hayden, (Annual Report, 1870, p. 149.) He here points out that the distinctness of the two basins was marked during the Tertiary period, and hence names the deposits of the western area the Wahsatch group, regarding

it at the same time as synchronous with those of the Green River epoch. The writer has attained the same opinion on paleontological grounds, and has hence employed the same name for both areas, namely, the Green River epoch.*

As already stated,† the upper or red-banded Tertiary beds of this locality yielded the following species:

Perissodactyle bones, two species.
Orotherium vasacciense.
Crocodilus, sp.
Alligator heterodon.
Trionyx scutumantiquum.
Emys testudineus.
gravis.
Clastes glaber.
Unio, two species.

The lower sandstone beds yielded the following mammals:

Bathmodon radians.
semicinctus.
latipes.
*Orotherium index.**

* Cope, Paleontological Bulletin, No. 17, 1873.

Phenacodus primævus.

West of the contact of Bear River with the Tertiary bluffs the strata consist of sandstone and conglomerates, and dip at about 30° to the northeast. Five hundred feet vertically below the *Bathmodon* bed a stratum of impure limestone crops out, forming the slope and apex of a portion of the bluff. In this I found the following vertebrates:

Reptiles: *Trionyx scutumantiquum.*
Emys (?) euthtunes.

Fishes: *Rhineastes calvus.*
Clastes glaber.

In comparing this list with that given for the lower beds of the Green River epoch, where they overlie the Bitter Creek coal, such resemblance may be observed as is sufficient to identify the two series.

This is the nearest to a determination of the age of the Evanston coal-bed, which Hayden regards as the most important west of the Missouri River, that I have been able to reach. From the limestone just described to the coal-bed, two miles to the west, the strata are very similar in character and apparently conformable, so that they appear to belong to the same series. Dr. Hayden confesses his inability to correlate them with those of Bear River City and Weber River, but discovered remains of plants which were identified with some of those known to occur in the Fort Union beds, on the Laramie Plains, and the Upper Missouri. If this be the case to a sufficient extent, the Evanston coal must be referred to that division of the Cretaceous period. This conclusion is, however, only provisional, and Dr. Bannister's remarks* are much to the point. He says:

"In the upper beds northeast of Evanston," (the ones I describe above,) "there seems to have been a considerable disturbance besides the mere tilting of the beds, and from the altered direction of the strike * we were

* Proceedings Acad. of Nat. Sciences, 1872, p. 279.
† Proceedings American Philosophical Society, 1872, p. 473.
* Hayden's Annual Report, 1872, p. 541.

led to suspect considerable lateral displacement with faulting, which might very possibly cause the appearance of the same beds both here and at the coal mines, although at first sight these would appear much higher in geological position. * * * I do not know the grounds of Prof. Cope's reference of the coal at this point to the Cretaceous, while he admits the Tertiary age at least of some of the overlying sandstones; but as we found no break nor line of demarkation in the whole 2,000 feet or more which we examined, and found our fossils in coal-bearing beds immediately above and conformable to the main coal, the facts, so far as they are known to me, do not seem sufficient for such identification.*" This point offers, therefore, a more complete continuity in stratification and mineral character from the Cretaceous to Tertiary deposits than any other which I have had the opportunity of examining.

Conclusion.

Having traced the transition series of the coal-bearing formations of the Rocky Mountain region from the lowest marine to the highest freshwater epochs, it remains to indicate conclusions. I have alluded but cursorily to the opinions of Mr. Lesquereux and Dr. Newberry as based upon the study of the extinct flora. They have, as is well known, pronounced this whole series of formations as of Tertiary age, and some of the beds to be as high as Miocene. The material on which this determination is based is abundant, and the latter must be accepted as demonstrated beyond all doubt. I regard the evidence derived from the molluscs in the lower beds, and the vertebrates in the higher, as equally conclusive that the beds are of Cretaceous age. There is, then, no alternative but to accept the result, *that a Tertiary flora was cotemporaneous with a Cretaceous fauna*,* *establishing an uninterrupted succession of life* across what is generally regarded as one of the greatest breaks in geologic time. The appearance of mammalia and sudden disappearance of the large mesozoic types of reptiles may be regarded as *evidence of migration, and not of creation.* It is to be remembered that the smaller types of lizards and tortoises continue, like the crocodiles, from mesozoic to Tertiary time without extraordinary modification of structure. It is the *Dinosauria* which disappeared from the land, driven out or killed by the more active and intelligent mammal. Herbivorous reptiles like *Agathaumas* and *Cionodon* would have little chance of successful competition with beasts like the well-armed *Bathmodon* and *Metalophodon.* There is good reason for believing that this incursion of mammalia came from the South.

It then appears that the transition series of Hayden is such not only in name but in fact, and that paleontology confirms, in a highly satisfactory manner, his conclusion "already shown many times, that there is no real physical break in the deposition of the sediments between the well marked Cretaceous and Tertiary groups."*

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* Hayden's Annual Report, 1872, p. 541.

* The circumstance of the discovery of a mesozoic Dinosaur, *Agathaumas sylvestris*, with the cavities of and between his bones stuffed full of leaves of Eocene plants (Lesquereaux,) would prove this proposition to be true, had no other fossils of either kind ever been discovered elsewhere.

* Annual report, 1870, p. 166. For instance, Gral. Surv., Colorado, 1869, p. 197, Dr. Hayden observes, "There is no proof, so far as I have obkervec in all the Western country, of true non-conformitp between the Cretaceous and lower Tertiary beds, and no evidence of any change in sediments or any catastrophe sufficient to account for the sudden and apparently complete destruction of organic life at the close of the cretaceous period."

SEC. II. LIST OF SPECIES OF VERTEBRATA FROM THE CRETACEOUS FORMATIONS OF THE WEST.

AVES.

NATATORES.

HESPERORNIS, Marsh.

HESPERORNIS REGALIS, Marsh. Amer. Jour. Sci. Arts, 1872, p. 56, l. c., 1872, p. 360.
Niobrara group, or No. 3 of the Smoky Hill.

GRACULAVUS, Marsh.

GRACULAVUS ANCEPS, Marsh. Amer. Jour. Sci. Arts, 1872, (iii,) p. 364.
Niobrara Cretaceous of the Smoky Hill.

SAURURÆ.

ICHTHYORNIS, Marsh.

ICHTHYORNIS DISPAR, Marsh. Amer. Journ. Sci. Arts, 1872, p. 344 (iv,) and 1873, p. 74, (v.) February, 1873.
Niobrara Cretaceous of the Smoky Hill.
ICHTHYORNIS CELER, Marsh, loc. cit., 1872, p. 406, (iv,) *Apatornis celer*, (name only,) loc. cit., Feb., 1873.
Niobrara Cretaceous of the Smoky Hill.

REPTILIA.

DINOSAURIA.

AGATHAUMAS, Cope.

The characters of this genus are derived from the typical species *A. sylvestris*, which is represented by dorsal and lumbar vertebræ, and an entire sacrum, with the ilia, one nearly entire; ribs, and a number of the bones the character of which have not yet been positively ascertained. One of these resembles the proximal part of the pubis; others, portions of the sternum, &c.

On eight, and perhaps nine, *vertebræ* anterior to the sacrum, there is no indication of the capitular articular face for the rib. This facet is found, as in *Crocodilia*, at or near the base of the elongate diapophyses. The centra are slightly concave posteriorly, and still less so on the anterior face, with gently convex margins. The neural canal is very small, and the neural arch short and quite distinct from the centrum, having scarcely any suture. The neural arch has a subcubical form, partly truncated above by the anterior zygapophyses. In like manner the base of the combined neural spine and diapophyses are truncate below by the square-cut posterior zyapophyses. The diapophyses are long and directed upward; they are triangular in section.

There are eight, and perhaps nine, sacral vertebræ, which exhibit a considerable diminution in the diameter of the centra. The diapophyses and neural arches are shared by two centra, the anterior part of the latter

Proceedings of the American Philosophical Society, 1872, p. 482.

bearing the larger portion of both. The diapophyses are united distally in pairs, each pair inclosing a large foramen. The anterior is the most massive rest on the ilium; the posterior pair the most expanded; the superior margins of its posterior edge form an open V with the apex forward on the neural arch of the fifth vertebra. On the last sacrals the diapophyses rise to the neural arch again. The exits of the sacral spinal nerves are behind the middles of the centra, and continue into grooves of the sides in all but the last vertebræ. The reduced and rather elongate form of the last sacral vertebra induces me to believe that this animal did not possess such large and short caudal vertebræ as is found in the genus *Hadrosaurus*, and that the tail was a less massive organ.

The *ilium* is much more elongate than the corresponding element in *Hadrosaurus*, *Cetiosaurus*, or *Megalosaurus*. Its upper edge is turned and thickened inward above the anterior margin of the acetabulum, and here the middle of the conjoined diapophyses of the second and third sacral vertebræ were applied when in place. In front of this point the ilium is produced in a straight line, in a stout, flattened form with obtuse end. Posterior to it its inner face is concave, to receive the second transverse rest of the sacrum, and the superior margin is produced horizontally toward the median line like the corresponding bone in a bird. The posterior part of the bone is the widest, for it is expanded into a thin plate and produced to a considerable length. From one of the margins (my sketch made on the ground represents it as the upper) a cylindric rod is produced still further backward. The base of the ischium is co-ossified with the ilium, and is separated from the iliac portion of the acetabulum. There is no facet nor suture for the pubis at the front of the acetabulum.

The ribs are compressed. There are no bones certainly referable to the limbs.

The form of the ilia distinguishes this genus from those known heretofore. It is also highly probable that it differs from some other genera in which the ilium is not known, *e. g.*, *Thespesius*, in the smaller and differently formed tail.

AGATHAUMAS SYLVESTRIS, Cope. Proceed American Philos. Soc., 1872, 482.

The last nine dorsal vertebræ have rather short centra, the most posterior the shortest. They are higher than wide; the sides are concave, the inferior face somewhat flattened. The neural arch is keeled behind from the canal to between the posterior zygapophyses, and a similar keel extends from the base of the neural spine to between the anterior zygapophyses. The neural spine is elevated, broad, and compressed; the diapophysis is convex above and concave along the two inferior faces, most so on the posterior. The articular face of the first sacral vertebra is wider than deep. The eight sacral vertebræ are flattened below, in all except the first by a plane which is separated from the sides by a longitudinal angle. The neural spines of the anterior five sacral vertebræ are mere tuberosities. A large sutural surface for attachment of a transverse process is seen in the posterior third of the eighth sacral vertebra, which descends nearly as low as the plane of the inferior surface. On the tenth sacral there is no such process, but its neural arch and that of the ninth support transverse processes. These are more like those of the dorsals in having three strong basal supporting ribs, the anterior and posterior extending for some distance along the arch.

Whether naturally or in consequence of distortion, the plate of the ilium is at a strong angle to the vertical axis of the acetabulum, and at the posterior part of it, the margin of the plate is free on the outside as well as the inside of the femoral articulation.

Measurements.

	M.
Length of nine posterior dorsal vertebræ	0.880
Length of nine sacral vertebræ, (36¾ inches)	.930
Length of right ilium, (two pieces, .84x.22) (41 inches)	1.060
Length of eighth dorsal from sacrum	.090
Length of base of neurapophysis	.085
Depth articular face	.153
Width articular face	.123
Length second from sacrum	.070
Depth articular face	.155
Width articular face	.137
Elevation neural canal	.045
Width neural canal	.028
Elevation to face of zygapophyses	.104
Elevation to base of neural spine	.150
Length diapophysis from lower base	.200
Length from capitular articulation	.125
Antero-posterior width above	.050
Antero-posterior base of neural spine	.070
Antero-posterior width at zygapophysis	.078
Length neural spine, (fragment)	.200
Width centrum, first sacral	.160
Depth centrum, first sacral, (to neurapophysis)	.145
Length centrum, first sacral	.100
Length centrum, seventh sacral	.100
Depth centrum, seventh sacral, (behind)	.085
Width centrum, seventh sacral, (behind)	.100
Expanse second sacral tranverse support, (22 inches)	.560
Length ilium anterior to acetabulum	.470
Length of acetabulum	.200
Length of posterior to acetabulum	.390
Width ilium at anterior extremity	.140
Width ilium at front of acetabulum	.210
Width ilium at posterior expansion	.250
Thickness above acetabulum	.060
Width of acetabulum	.105
Width of basis of ischium	.085
Width of shaft of a rib	.062

Other bones not yet determined will be included in the description in the final report.

This species was no doubt equal in dimensions to the largest known terrestrial saurians or mammals.

HADROSAURUS, Leidy.

Cretaceous reptiles of the United States 1865, p. 76, Proceedings of the Academy of Natural Sciences, Philadelphia, 1856, p. 218.

HADROSAURUS MIRABILIS. Leidy.

Proceedings of the Academy, Philadelphia, 1868, 199. Cope, extinct; Batrachia, etc., 1868, 198. *Trachodon mirabilis*, Leidy; Proceedings Academy, Philadelphia, 1856, 72; Transactions American Philosophical Society, 1860, 140.—From the bad lands of Judith River, Montana. Known only from teeth.

HADROSAURUS OCCIDENTALIS.

Cope; Extinct Batrachia, etc., p. 98. *Thespesius occidentalis*, Leidy. Proceedings of the Academy, Philadelphia, 1856, p. 311. Transactions of the American Philosophical Society, 1860, p. 151.

From the lowest member of the lignite formation at Grand River, Nebraska.

Referred, by Professor Leidy, to a distinct genus under the name of *Thespesius*, on account of the slightly opisthocoelian character of the large caudal vertebra. Teeth unknown.

Fragments of a large Dinosaur from Colorado were found associated with species of tortoises identical with those found in Dakota, in the horizon which contains the *H. occidentalis*, (see under head of *Cionodon arctatus*,) and may possibly belong to it. I have no identical parts in the two for comparison.

Char. specif. The largest fragment of a long bone is probably from the proximal end of the tibia; it includes the curved inner border of the side, and the inner posterior tuberosity, with five inches of the inner head side of the shaft. The superficial layer is marked with numerous closely-placed longitudinal grooves, which are replaced by a few coarser and deeper ones which interrupt the anglewith the articular surface, giving it a lobate margin. There was probably a prominent cnemial crest. Another fragment exhibits one flat plane, and a concave posterior face. It comes from near the extremity of humerrus or femu; it was found near the fragment of tibia. The sacral vertebra is probably that of an animal not fully grown, as it was not co-ossified with those adjacent. The articular extremities are expanded, and present distinct faces for articulation for the large diapophyses. The one extremity is more expanded and less thickened; the other more thickened and less dilated: on this rests the greater part of the base of the neural arch. Just at the extremity of this base the large sacral nervous foramen issues, which is continued in a wide groove downward between the transverse expansions. Inferior surface convex. As compared with the fourth sacral vertebra of *Agathaumas sylvestris*, Cope, which it nearly resembles in size, it is to be observed that the anterior extremity is less expanded transversely as compared with the posterior; that the bases of support for the anterior diapophyses are not produced downward so far; that the sides of the centrum are nearly vertical and not sloping obliquely toward the middle line; and that there is no inferior plane separated from the lateral by a longitudinal angle, as in *A. sylvestris*. It differs in like manner from the third and second sacral vertebræ, and still more from the first of the latter saurian.

Measurements.

		M.
Length centrum of fourth sacral vertebra		.092
Transverse diameter	in front	.103
	at middle	.072
	posteriorly	.121
Vertical diameter posteriorly		.092
Diameter head of tibia antero-posteriorly		.250

HADROSAURUS AGILIS. Marsh.

Amer. Journ. Sci. Arts, 1872, p, 301

From the Niobrara or Cretaceous, No. 3, of Western Kansas.

Smaller than the preceding species.

CIONODON, Cope.

Bulletin of the United States Geological Survey of the Territories, 1874, p. 10.*

Remains of species of Dinosauria were obtained at two localities in Colorado not many miles apart, the greater number at one of them, from which also all the crocodilian and turtle remains were derived. Those from the other deposit consist of portions of limb-bones apparently of a single individual of gigantic size. The more abundant fragments are referable to three species. A fragment of a limb-bone is very similar to portions from the other locality, and associated is a sacral vertebra of appropriate size and characters. All of these were therefore referred provisionally to a single species under the name of *Agathaumas milo*, but are here described under *Hadrosaurus occidentalis.* The remaining specimens fall into two series. In the one the bones are occupied by a heavy mineral and the surfaces covered by a white layer which is marked by irregular ridges, as though produced by deposit along the lines of small adherent foreign bodies. In the other set the bones are lighter, more spongy, and not covered with the white layer; some of them are stained by the sesquioxide of iron. Both present vertebral and limb bones, which are related appropriately as to size and structure; that is, the larger limb-bones have the same mineral character as the larger vertebræ, and the smaller as the smaller. These limb-bones represent corresponding parts in the two, and differing widely confirm, the belief in the existence of two species indicated by the different types of vertebræ. In these fossils, then, I see evidence for the existence of two species of two genera, which I name, the larger *Polyonax mortuarius*, the smaller, *Cionodon arctatus.* Both genera present a solid cancellous filling of femora, tibiæ, and other long bones, and hence differ from such genera as *Hadrosaurus*, *Hypsibema*, *Lælaps*, and others. *Cionodon* differs in dentition from all *Dinosauria* where that part of the structure is known, but it remains to compare *Polyonax* with *Troödon* and *Palæoscincus* of Leidy, which are known from the teeth only, while no portions of dentition are preserved with the specimens at my disposal.

Char. genericus. Established primarily on a portion of the right maxillary bone, with numerous teeth in place. The posterior portion exhibits a suture, probably for union with the palatine bone, while the rest of the interior margin is free. It is removed some distance from the tooth-line in consequence of the horizontal expanse of the bone, while the outer face is vertical.

The teeth are rod-like, the upper portion sub-cylindric in section, with the inner face flattened from apex to base, while the lower half is flattened externally by an abrupt excavation to the middle, for the accommodation of the crown of the successional tooth. The inner face of the tooth, from apex to base, is shielded by a plate of enamel, which is somewhat elevated at the margins, and supports a keel in the middle, thus giving rise to two shallow longitudinal troughs. The remainder of the tooth is covered with a layer of some dense substance, possibly cementum, which overlaps the vanishing margins of the enamel. The outer inferior excavation of the shaft presents a median longitudinal groove, to accommodate the keel of the closely appressed crown of the successional tooth. The apex of the tooth being obtusely wedge-shaped, the functional tooth is pushed downward and transversely toward the inner side of the jaw. The tooth slides downward in a closely-fitting vertical groove of the outer alveolar wall. The inner wall is oblique, its section forming, with that of the outer, a V; it is furrowed with grooves similar and op-

* Where the proof-reader made it *Cinodon.*

posite to those of the outer wall, but entirely disconnected from them. The base of the shank of the functional tooth, on being displaced by the successional, slides downward and inward along the grove of the inner side, each lateral movement being accompanied by a corresponding protrusion. At the most, three teeth form a transverse line, namely, one new apex external, one half-worn crown median, and the stump or basis of a shank on the inner. The new crowns are, however, protruded successively in series of three, in the longitudinal direction also. Thus, when an apex is freshly protruded, the shank in front of it is a little more prominent, and the third stands beyond the alveolar border. As each shank increases somewhat in diameter downward, in the *C. arctatus*, the section increases in size with protrusion; hence, before the appearance of a new crown outside of it, there are but two new functional teeth in a cross row. Thus, in the outer longitudinal row, only every third tooth is in functional use at one time; in the middle series all are in use, while in the inner every third one is simultaneously thrown out in the form of a minute stump of the shank, if not entirely ground up.

The dorsal vertebræ are opisthocoelian, the anterior more compressed than the posterior; capitular articular faces, if existing, are slightly marked. The zygapophyses are but little prominent beyond the arch. A caudal vertebra is plano-concave, with rather depressed centrum a little longer than broad. The condyles of the femur have a short arc and chord; the head of the tibia displays a large cnemial crest, but is not emarginate behind.

The type of dentition exhibited by this genus is perhaps the most complex known among reptiles, and is well adapted for the comminution of vegetable food. While the mechanical effect is quite similar to that obtained by the structure of the molars of ruminating mammals, the mode of construction is entirely altered by the materials at hand. Thus the peculiarly simple form and rapid replacement of the reptilian dentition, is by a system of complication by repetition of parts, made to subserve an end identical with that secured by duplication of the crown of the more specialized molar of the mammal.

Cionodon is evidently allied to *Hadrosaurus*, but displays greater dental complication. In that genus, according to Leidy, the successional crowns appear on the *front* side of the shank of the tooth, not behind, and below the base of the enamel area, so that the tooth is distinguished into crown and shaft. It also follows from this arrangement that the successional tooth does not appear until its predecessor has been worn to the root, in which case there can be only one functional tooth in a transverse direction instead of two or three.

CIONODON ARCTATUS, Cope.

Bulletin, l. c., p. 10.

Char. specif. The enamel plate of the tooth extends from apex to near the base of the shaft. Its margins are thickened and without serration, while the surface generally is nearly smooth. The dense layer over the remainder of the tooth is much roughened by a great number of short, serrate, and somewhat irregular longitudinal ridges.

Measurements.

	M.
Width of alveolar groove	0.0120
Length of a triad of teeth on alveolus	.0140
Length of an unworn tooth	.0250

Diameter of surface of attrition of a tooth of the middle row, longitudinal	.0063
Diameter of surface of attrition of a tooth of the middle row, transverse	.0072
Width of maxillary bone	.0350
Depth of maxillary at inner margin	.0140

What I suppose to be the posterior end of the maxillary bone exhibits the grooves to near its apex, as well as a considerable surface of articulation for the malar.

Two dorsal vertebræ are preserved, whose neural arches are co-ossified, with trace of suture remaining. Both articular faces exhibit a transverse fossa for ligamentous or bursary attachment. Round these, on the convex face, there are transverse rugosities, while oblique-ridged lines descend on each side from the floor of the neural canal. The centra are shorter than deep, and subquadrate in a horizontal section. The sides are concave; the anterior are compressed with lenticular vertical section with angle below. The more posterior is less compressed, and the surface is smooth; in the anterior it is thrown into weak longitudinal ridges near the edges of the articular extremities. There are large nutritious foramina on the sides. The neurapophyses are excavated vertically on their posterior edges. Neural arch on the anterior dorsal, a broad, vertical oval. A caudal vertebra is rather elongate and depressed; as it has no diapophysis it is not from the anterior part of the series. There is no prominent lateral angle, but the two inferior angles connecting the chevron facets are well marked. Neurapophysis only measuring halt the length of the centrum. The articular faces exhibit the same transverse fossa as is seen in the dorsals. The anterior is plane, the posterior uniformly concave.

Measurements.

	M.
Anterior dorsal, length of centrum	.074
Anterior elevation of articular face	.073
Anterior width of articular face	.070
Anterior vertical diameter of neural canal	.027
Anterior elevation of anterior zygapophyses	.122
Middle dorsal, length of centrum	.068
Middle elevation of articular face	.085
Middle width of articular face	.080
Middle caudal, length of centrum	.062
Middle elevation of articular face, (at canal)	.047
Middle width of articular face	.068
Middle width between inferior angles	.024
Middle width of neural canal	.013

The *femur* is only represented by the distal end with the condyles perfectly preserved. The latter form a single trochlear surface, whose borders form arcs of circles. It is slightly hour-glass shaped, chiefly by excavation of the posterior face, which is, however, shallow, the deep fossæ seen in *Hadrosaurus* and other genera being absent. The area of the articular cartilage is clearly marked out, and the dense surface of the shaft is marked with delicate striæ which terminate at the edge of the former. One side of the end of the bone is nearly plane, the other is longitudinally excavated; some shallow grooves furrow the angle with the trochlear face. The section of the shaft, three inches from the

end, is a wide transverse parallelogram. This bone looks no little like the distal end of a metapodial bone, but there are various reasons why it is more probably femur or humerus. The form of the tibia especially determines it to be the former element.

The head and distal end of the *tibia*, with six inches of the shaft, are preserved. The former relates with the end of the femur, resembling it both in size, simplicity of contour, and details of surface. The form is crescentoid, one horn being the cnemial crest, the other posterior and replaced by a short truncation. The inner (convex) face is rendered angular by a median tuberosity, and all round this margin, shallow grooves cut the solid angle at irregular distances. The articular face displays the smooth area, and the shaft the delicate striæ, seen in the femur. The distal end is unsymmetrically lenticular in section, one side being more convex; the articular face is rugose, showing a fixed ligamentous articulation for the astragalus. The convex face of the shaft is coarsely striate-grooved near the extremity; on the other side the intervening ridges are represented by exostoses or rugosities. The flatter side becomes the more convex on the lower part of the shaft.

Measurements.

		M.
Transverse diameter of condyles of femur		.082
Transverse diameter of shaft of femur		.053
Diameter fore and aft	of middle of condyles	.054
	of side of condyles	.069
	of shaft	.038
Diameter of head of tibia	greatest	.102
	fore and aft	.096
	transverse	.060
Diameter of shaft of tibia proximally	transverse	.050
	fore and aft	.045
Diameter distal end of tibia	transversely	.115
	fore and aft	.060

Remarks.—If the bones above described as pertaining to the hind limb are really such, they are smaller as compared with the dorsal vertebræ than in *Hadrosaurus foulkei*, and indicate an animal the size of a horse.

POLYONAX, Cope.

Char. Gen:

A species considerably larger than the last, represented by vertebræ and numerous fragments of limb bones. The most characteristic of the former are two probably from the posterior dorsal region, which are somewhat distorted by pressure. The more anterior is shorter than the other, and exhibits both articular faces slightly concave, the one more so than the other. They are higher than wide, and the border is scolloped above for the capitular articulation for the rib. There are numerous nutritious foramina, and some ligamentous pits on the articular surfaces. The inferior face is rounded. In the longer vertebra both faces are more strongly concave, and at each end of the lower side there is an obtuse hypopophysial tuberosity. The sides of the centra of both vertebræ are concave, The neueral canals are relatively small, and the neurapophyses co-ossified. A third vertebra without arches, is similar in specific gravity, though without the white surface-layer of the others. It is appropriate in size and form to this species, and is peculiar in its flat form, resembling the ante-

terior dorsals of the *Hadrosaurus*. In this respect it is related to the shorter vertebra of the two above described as the latter is to the longer. The surface of the posterior articular face is damaged; it was not concave, and is now slightly convex; the anterior is preserved, and is concave.

POLYONAX MORTUARIUS, Cope.

The articular faces are deeper than wide in the vertebræ; the sides are smooth; the lower faces narrowed and probably keeled.

Measurements.

	M.
Anterior dorsal, length of centrum	.048
Anterior elevation to neural canal	.094
Anterior width	.094
Median dorsal, length of centrum	.057
Median elevation to neural canal	.117
Median width	.083
Posterior dorsal, length of centrum	.092
Posterior dorsal, elevation	.104
Posterior dorsal, width	.083
Posterior dorsal, diameter of neural canal	.015

The measurement of the neural canal is made near the base of the neurapophyses, and is probably a little affected by pressure.

The limb-bones embrace portions of tibia, fibula, and some others not yet determined. The portion of tibia is from the base of the cnemial crest, so that one extremity is trilobate, the other transverse oval. The former outline indicates two posterior tuberosities. The bone is solid, and the superficial layer, for three, MM. or less, is so dense and glistening as to resemble cementum. Portions referred to fibulae have a subcrescentic section, with narrowed width in one direction. Two fragments of shafts of long bones I cannot determine either as belonging to the limbs or pelvis. They belong to opposite sides; each is oval in section, and the diameter regularly contracts to one end. One side is slightly convex in both directions; the other is less convex transversely, and gently convex longitudinally. A peculiarity consists of a central cavity present in both at the fractured large end, which is bordered by a layer of dense bone like the outside.

Measurements.

	M.
Transverse diameter of tibia fragment below cnemial crest	.125
Anteroposterior diameter of tibia fragment at base of crest	.095
Width of fragment of fibula	.073
Thickness of do.	.035
Length of fragment of unknown bone	.145
Proximal diameter of unknown bone	.088
Distal do.	.065

The above measurements indicate a much larger animal than the *Cionodon arctatus*, and one not very different in size from the *Laelaps aquilunguis*.

PALÆOSCINCUS, Leidy.

Proceedings Academy, Philadelphia, 1856, p. 72.

PALÆOSCINCUS COSTATUS, Leidy, l. c.
Bad lands of Judith River, Montana.
Founded on dental characters only.

TROODON, Leidy.

Loc. cit., 1856, p. 72. Transac. Amer. Philos. Society, 1860, 147.
TROÖDON FORMOSUS, Leidy, l. c.
Bad lands of Judith River, Montana.
Founded on teeth only.

AUBLYSODON, Leidy.

Proceed. Acad. Natural Science, Philadelphia, 1868, p. 198. *Dinodon* Leidy, l. c., 1864, 72, not of Duméril.

AUBLYSODON HORRIDUS, Cope. Extinct Batrachia, etc., N. America, p. 120. *Dinodon horridus.* Leidy, Proceed. Academy, Philadelphia, 1856, 72. Transac. Amer. Philosophical Soc., 1860, 140. *Aublysodon mirandus*, Leidy. Proc. Academy, 1868, 198.
From the bad lands of Judith River, Montana.
Represented by teeth.

PTEROSAURIA.

PTERODACTYLUS, Cuv.

PTERODACTYLUS UMBROSUS, Cope. Proceed. Amer. Philos. Society, 1872, p. 471. *(Ornithochirus,)* (published March 9, 1872.)
Niobrara Chalk of Kansas.
PTERODACTYLUS INGENS, Marsh. American Jour. Sci. Arts, 1872, April, (published March 7, 1872.)
Niobrara Chalk of Kansas.
PTERODACTYLUS OCCIDENTALIS, Marsh. Loc. cit., April, 1872, (published March 7.) *Ornithochirus harpyia*, Cope. Proceed. Amer. Philos. Soc., 1872, 471, (published March 9.) *Pterodactylus owenii*, Marsh, loc. cit., 1871, p. 472, not of Bowerbank.
Niobrara Cretaceous of Kansas.
PTERODACTYLUS VELOX, Marsh, l. c., April, 1872.
Niobrara Cretaceous of Kansas.

CROCODILIA.

HYPOSAURUS, Owen.

Journ. Geological Soc. London, v, 383.
HYPOSAURUS VEBBII, Cope. Proceed. Amer. Philos. Soc., 1872, p. 310.
Benton or No. 2 Cretaceous of Kansas.

BOTTOSAURUS, Agass.

Cope. Proceed. Amer. Philos. Soc., 1871, p. 48

BOTTOSOURUS PERRUGOSUS, sp. nov.

Represented by numerous fragments, with vertebræ and portions of skull which accompanied the Dinosaurian and turtle remains from Eastern Colorado, already alluded to.

A portion of the left dentary bone containing alveoli for ten teeth shows that this species is not a gavial. The dental series passes in a curve from the inner to the outer sides of the bones, one or two alveoli behind being probably bounded on the inner side by the splenial only, as in *B. macrorhynchus*, when that bone is in place. The dentary is compressed at this point; in front it is depressed. There is a slight difference in the sizes of the alveoli, but not such as is usual in Tertiary crocodiles. The external face of the bone exhibits deep pits in longitudinal lines. The angle of the mandible is depressed; the cotylus of articulation is partially concealed on the outer side by the elevation of the surangular, whose upper border is parallel with the inferior margin of the ramus for two inches to where it is broken off. The outer face of this region marked by irregular coarse ridges more or less inosculating, separated by deep pits. The lower posterior half of the angular bone is smooth.

A posterior dorsal or lumbar vertebra has a depressed cordate articular cup. The zygapophyses are large and widely spread and strengthened by obtuse ridges running from the base of the neural spine to the posterior margin of the anterior and the posterior outer angle of the posterior. One pit at basis of neural spine in front; two before. Ball prominent; sides of centrum concave.

Measurements.

	M.
Length of fragment of ramus	.100
Width in front	.034
Depth behind	.032
Length of eight alveoli	.069
Diameter of largest alveolus	.012
Diameter of smallest	.007
Width of base of angle of ramus	.048
Depth at surangular	.034
Length of centrum of vertebra	.045
Width of articular cup	.031
Vertical diameter of cup	.025
Vertical diameter of neural arch	.011
Expanse of anterior zygapophyses	.056

The specimen is adult, and indicates an animal about the size of the alligator of the Southern States. Its reference to the present genus is provisional only.

BOTTOSAURUS(?) HUMILIS, Leidy. *Crocodilus humilis*, Leidy. Proceed. Acad. Nat. Sciences. Phila. 1856, p. 75. (Teeth only.) Bad lands of Montana, (Judith River.)

SAUROPTERYGIA.

POLYCOTYLUS, Cope.

POLYCOTYLUS, LATIPINNIS, Cope. Extinct. Batr. Reptilia N. Am. 1869, p. 36, Plate I, Figs. 1–13. Hayden's Geol. Survey, Wyoming, 1870. p. 388.

From the Niobrara chalk of Kansas.

PLESIOSAURUS, Conyb.

PLESIOSAURUS GULO, Cope. Proceedings Academy Philadelphia, 1872, p. 128.
Niobrara Cretaceous of Kansas.

PLESIOSAURUS OCCIDUUS, Leidy. *Nothosaurus occiduus*, Leidy. Proceed. Academy Philadelphia, 1870, p. 74; Report Geol. Survey Territories, (4to,) 1873, I, p. 345; tab. xv., figs. 11–13.
Lignite Cretaceous of Moreau R., Dakota.

PIRATOSAURUS, Leidy.

PIRATOSAURUS PLICATUS, Leidy. Cretaceous Reptiles of North America, p. 29, tab. xix, fig. 8.
Cretaceous of the Red River, Minnesota.

ELASMOSAURUS, Cope.

ELASMOSAURUS PLATYURUS, Cope. Notes on Geology of Southern Div. Pacific R. R., by J. Leconte. 1868, 68. Extinct Batrachia Reptilia N. America, etc. 1869, p. 44. Hayden Geol. Survey Terr's, 1870, Wyoming, p. 393. *Discosaurus carinatus*, Cope. Leconte's notes, l. c.
Niobrara Cretaceous of Kansas.

ISCHYROSAURUS, Cope.

Extinct Batr. Rept. N. America, 1869, p. 38. *Ischyrotherium*, Leidy. Proceed. Academy Philadelphia, 1856, p. 89. Transac. American Philos. Soc., 1860, p. 150.

ISCHYROSAURUS ANTIQUUS, Cope, l. c. *Ischyrotherium antiquum*, Leidy, l. c. Trans. Amer. Philos. Soc. Tab. x, figs. 8–17.
Lignite period between Moreau and Grand Rivers, Nebraska.

TESTUDINATA.

PROTOSTEGA, Cope.

Proceedings Am. Philos. Society, 1872, p. 422.

PROTOSTEGA GIGAS, Cope, l. c.
From the Niobrara Cretaceous of Kansas.

TOXOCHELYS, Cope.

Proceed. Academy Nat. Sciences, Philadelphia, 1873, p. 10.

TOXOCHELYS LATIREMIS, Cope, l. c. ? *Cynocercus incisus*, Cope, l. c., 1872, p. 129. Leidy Report U. S. Geol. Survey Territories, I, p. 279, tab. xxxvi, figs. 17–21.
Niobrara Cretaceous of Kansas.

CYNOCERCUS, Cope.

Proceedings Amer. Philos. Soc., 1872, 308.

CYNOCERCUS INCISUS, Cope., l. c.
Niobrara Cretaceous of Kansas.

TRIONYX, Geoffr.

TRIONYX FOVEATUS, Leidy. Proceed. Academy, Philadelphia, 1856, p. 73. Transac. Amer. Philosoph. Society, 1860, 148, tab.

Bad lands of Judith River, Montana.

TRIONYX VAGANS, Sp. nov.

Trionyx ? foveatus, Leidy. Proceed. Acad. Nat. Sci., Philadelphia, 1856, p. 312.

Represented by a number of fragments of costal bones, and perhaps of sternals also. The former are rather light or thin for their width, and are marked with a honeycomb-pattern of sculpture, in which the ridges are thin and much narrower than the intervening pits. They incline to longitudinal confluence at and near the lateral sutures. Several areæ are not unfrequently confluent in a transverse direction near the middle of the bone.

Width of costal bone	.0370
Thickness of costal bone	.0045
Four and five, areæ in	.010 m.

This species differs from the *T. foveatus*, Leidy, in the much narrower interareolar ridges and larger areæ and in their longitudinal confluence at the margins, characters exhibited by numerous specimens.

Lignite cretaceous of Colorado; near the mouth of the Big Horn River, Montana; Long Lake, Nebraska; found at the last two localities by Dr. Hayden.

PLASTOMENUS, Cope.

Annual Report U. S. Geol. Survey, 1872, p. 617.

PLASTOMENUS(?) PUNCTULATUS, Sp. nov.

Established on a costal bone found in association with the preceding species, and referred to the genus *Plastomenus* provisionally, and with a probability that it will be found not to pertain to it when fully known. That genus has so far only been found in the Eocene formation. The bone is rather thin and sufficiently curved to indicate a convex carapace of moderate thickness. The surface is marked with closely packed shallow pits without material variation of form on the proximal half of the bone. The result is an obsolete sculpture quite similar to that seen in some species of the genus to which it is at present referred.

Width of costal bone	.0230
Thickness of costal bone	.0033
Number of pits in .010 m	six.

Lignite Cretaceous of Colorado. Also several fragments from Long Lake, Nebraska, from Dr. Hayden.

PLASTOMENUS(?) INSIGNIS, Sp. nov.

Represented by a portion of the right hyposternal bone of a tortoise about the size of the last species, and from the same locality. The specimen resembles in its sculpture such species as the *Plastomenus trionychoides*, and in structural character the species of *Anostira*, but it is

scarcely probable that it belongs to either genus. It is flat, and has a narrow, straight, inguinal margin at right angles to the fine suture with the hyosternal. The suture with the postabdomial is partially gomphosial. Surface dense, polished, marked externally with a reticulate sculpture of narrow ridges separating larger and smaller areas wider than themselves. Marginal edge thinner.

	M.
Length of hyposternal fore and aft	.025.
Thickness of hyposternal at front	.004.
Pits in .010 m	six.

Lignite Cretaceous of Colorado.

ADOCUS, Cope.

Proceedings Academy of Natural Sciences, Philadelphia, 1868, 235. Proceedings American Philosophical Society, 1870, November.

ADOCUS(?) LINEOLATUS, Sp. nov.

Established on a number of fragments from different exposures of the lignite beds, primarily on a vertebral and sternal bone from the same locality as the preceding specimen. As the diagnostic portions of this specimen are wanting, it is referred to this genus provisionally, and because the structure and sculpture of the parts resemble most nearly known species of it from the Cretaceous greensand of New Jersey.

The sternal bone is flat, and presents the wide and transverse sutures forming the usual right angle, and of a rather coarse character of a medium serrate keel with pits on each side for the reception of corresponding pits. The vertebral bone is rather thick, and is shallowly emarginate in front. The sculpture consists of delicate obscure parallel lines which are more or less interrupted and occasionally joined, so as to inclose faintly-marked areolæ.

	M.
Width of vertebral bone in front	.0135
Greatest of vertebral bone	.0280
Thickness of vertebral bone	.0070
Thickness of sternal bone	.0080

From lignite of Colorado, and mouth of Big Horn River, Montana.

COMPSEMYS, Leidy.

COMPSEMYS VICTUS, Leidy. Proceedings Academy Natural Sciences, Philadelphia, 1856, p. 312.

Lignite of Long Lake, Nebraska; Cretaceous of Colorado.

COMPSEMYS OBSCURUS, Leidy, Cope.

Extinct Batrachia, &c., p. 124. *Emys obscurus*, Leidy. Proceedings Academy, 1856, 812.

Lignite of Long Lake, Nebraska.

PYTHONOMORPHA.

The reptiles of this order are the most abundant in the marine Cretaceous of Kansas, or the Niobrara Group of Dr. Hayden. Material acquired since my first account confirms the idea there maintained that

they were of an elongate snake-like form, which the two pairs of short paddles did not materially modify. These limbs were situated in the anterior half of the length, the resulting form being like that of some of the snake-like terrestrial lizards at present inhabiting various countries, especially of the southern hemisphere. Although I do not possess any specimen with complete vertebral column, an approximate idea of its length may be gained by comparison of parts which are more or less complete in different species. Thus in *Clidastes propython* the cervicals and dorsals number about 33; in a *Liodon latispinus* the lumbars number 7, and a series of caudals with diapophyses 32, with but little diminution in size, the last with stout but reduced diapophysis. Caudals without diapophysis in a species of *Platecarpus* number 27, and there were at least as many, probably a larger number, beyond these.

The well-distinguished genera of the order known from North American strata are the following:

I. Cervical hypopophyses, separate, articulating.
   A zygosphenal articulation.
      Chevron bones co-ossified with centra................*Clidastes*
      Chevron bones free...................................*Sironectes*
   No zygosphenal articulation.
      Teeth subcylindric facetted; chevron bones free...*Platecarpus*
      Teeth mostly compressed, cutting; humerus with narrow extremities; chevron bones free......................*Liodon*
      Teeth subcylindric facetted; chevron bones co-ossified...*Mosasaurus*
II. Cervical hypophophyses continuous and entire.
   No zygosphen..*Baptosaurus*

CLIDASTES, Cope.

Proceedings Academy Philadelphia, 1868, p. 233; Transactions American Philosophical Society, 1870, p. 211; *Edestosaurus*, Marsh, American Journal of Science and Arts, 1871, June; Cope, Proceedings American Philosophic Society, 1871, December.

There are specific differences in the form of the palatine bones in this genus from the more transverse or expanded type of the *C. propython* to that of the *C. planifrons*, where they are narrowed posteriorly in some degree, to the *C. tortor*, where they are vertically placed in the posterior half. *Clidastes* is nearly added to *Platecarpus*, with which *Sironectes* associates it as an intermediate genus. The number of species already known is considerable, and the genus is divided into sections for convenience of reference.

A. Centra of dorsal vertebræ depressed.

a. Frontal bones without median keel.

Clidastes planifrons, Sp. nov.

A large species represented by large portions of the cranium including quadrate bone, by cervical and dorsal vertebrae and fragments of other elements all belonging to one individual. They are well preserved and have suffered but little from distortion.

The frontal bone is especially massive, and is plane on the superior surface. The superciliary borders are strongly concave, a feature either little or not at all marked in other species known to me. It is thickened, but the fossa of the postfrontal bone extends far toward the front and middle on the inferior surface. Anterior to the prefrontal

angle the frontal contracts, narrowing regularly to the line of the nares. The prefontal has the remarkable form characteristic of *Clidastes stenops*, that is with the exposed face subvertical or steeply roof-shaped instead of horizontal. A groove descends on each side to each nareal orifice, and the intervening longitudinal ridge is deeply fissured by a parallel groove. The parietal fontanelle is entirely in the parietal bone. The postfrontal is massive.

The *quadrate* bone presents a very prominent internal angle as in other *Clidastes*, and has the posterior hook much prolonged downward and inward, with a button and surrounding groove on its inner side. The stapedial pit is narrow oval, as in *Liodon proriger*. The median posterior ridge is prominent and united with the distal internal longitudinal, extending to the narrow posterior angle of the distal articular face. There is no internal ridge, but a strong obtuse ridge extends along the outer side, turning backward into a rough process opposite the origin of the base of the ala. Between this and the distal articular face is a subtriangular rugose area.* The palatine bone has its anterior and posterior extremities broken away, the fragment supporting six teeth. The bone is flat, much as in the species of *Platecarpus*, the tooth-line passing from the inner margin behind to the outer before; the roots being more exposed on the external side; the external process is stout. The crowns of the palatine teeth are curved with lenticular section, one face being much more convex than the other; the enamel is shallowly striate-groove.

The articular faces of the cervical *vertebrae* are all transversely oval, not much depressed; those of the dorsals are also transverse, but less so than the cervicals. Five cervicals and nine dorsals are preserved. The hypapophyses, both fixed and free, are very large and stout. The odontoid is large and prominent, and deeper than long. The diapophyses are short, and send a narrowed extension forward to the rim of the cup on all the cervicals and three dorsals. The vertical portion of their surfaces diminishes anteriorly as the horizontal extends, till, on the axis, it is horizontally subtriangular in outline. The zygosphen is smaller on the anterior than the posterior vertebrae; on the latter the zygantrum possesses special facets for it. The cups, especially of the dorsals, are emarginate for the neural canal. A smooth band borders the circumference of the ball in front. The surface in general is smooth, with rugose lines and grooves extending to the articular face of the fixed hypapophysis, and apex of the free, and on the upper roof-like surface of the posterior zygapophyses. The inferior surfaces of the centra display a more or less prominent longitudial median ridge.

* The nomenclature of these ridges is that proposed in the extinct Batrachia, etc., p. 183, with "internal" changed to *external*, and vice versa, in accordance with the observations of Prof. Marsh.

	M.
Depth of mandible at cotylus	.040
Depth of sphenoid condyle	.032
Width of proximal articular surface of quadrate, (transverse)	.023
Width of distal articular surface	.043
Length of third cervical centrum	.062
Depth at bottom of third cervical centrum	.030
Width at bottom of third cervical centrum	.037
Length of articular end of fixed hypapophysis	.025
Length of free hypopophysis	.029
Length of a median dorsal centrum	.072
Width at bottom of a median dorsal centrum	.048
Depth at bottom of a median dorsal centrum	.040

This species needs only to be compared with the *Clidastes stenops*, Cope, which exhibits the same peculiarity of roof-shaped pre-frontal bones. That species has the cervical articular faces entirely round; the frontal bone is keeled in the middle, and the palatine much more vertically compressed. The quadrate bone differs in various respects; among others, in the round form of the stapedial pit. As compared with the species described by Professor Marsh as *Edestosaurus dispar* and *E. velox*, it differs in the form of the quadrate, which in these species is much as in *C. tortor* and *C. stenops; i. e.*, with short proximal hook, oblique inferior articular surface, round pit, &c. In this species the quadrate is truncate distally, &c.

This fine species was discovered by the veteran geologist Prof. B. F. Mudge, during his annual expedition of 1873.

aa. Frontal bones with median keel:

CLIDASTES TORTOR, Cope; *Edestosaurus tortor*, Cope, Proceed. Amer. Philos. Society, Dec., 1871.

Niobrara Cretaceous of the Smoky Hill River.

CLIDASTES STENOPS, Cope; *Edestosaurus stenops*, *loc. cit.* Hayden's Annual Report U. S. Geol. Survey, 1871, p. 330.

Niobrara Cretaceous of the Smoky Hill River.

CLIDASTES REX, Marsh, Amer. Journ. Sci. Arts, 1872, June.

Niobrara Cretaceous of the Smoky Hill River.

CLIDASTES AFFINIS, Leidy, Report U. S. Geol. Survey Terrs., I, p. 281, tab. xxxiv, f. 6–9 and 11.

Niobrara Cretaceous of the Smoky Hill River.

aaa. Frontal bones unknown:

CLIDASTES DISPAR, Marsh; *Edestosaurus dispar*, Marsh, Amer. Journ. Sci. Arts, 1871, June.

Niobrara Cretaceous of the Smoky Hill River.

CLIDASTES VELOX, Marsh; *loc. cit.* (*Edestosaurus*).

Niobrara Cretaceous of the Smoky Hill River.

CLIDASTES WYMANII, Marsh, *loc. cit.*

Niobrara Cretaceous of the Smoky Hill River, Western Kansas.

CLIDASTES PUMILUS, Marsh, *loc. cit.*

Niobrara Cretaceous of the Smoky Hill River.

A A. Centra of dorsal vertebræ compressed:

CLIDASTES CINERIARUM, Cope, Proceed. Amer. Philosophical Soc., 1870, 583.

Niobrara Cretaceous of the Smoky Hill.

SIRONECTES, Cope.

The characters of this genus are such as to unite closely that which precedes it with that which follows in the present enumeration. It is more nearly allied to *Platecarpus* in the only species known, where the zygosphen is weak, but articulates with special facets on the lateral walls of the zygantrum. The form of the bones of the limbs is unknown.

SIRONECTES, ANGULIFERUS. *Sp nov.*

Established on a portion of the left mandible, with a series of thirty one vertebræ of a single individual discovered by Prof. B. F. Mudge in the gray calcareous shale of Trego County, Kansas.

Some of the vertebræ have suffered from pressure, but the centrum of an anterior cervical is little or not at all distorted, as are also many of the caudals. All the dorsals and cervicals have transversely oval articular faces openly notched above for the neural canal. The fixed hypapophyses are large, the last one small and subconic, abruptly following a large truncate one. The three succeeding dorsals are keeled below; the keel of the last low and obtuse. The zygosphen is weak and deeply notched in the middle; on the anterior cervicals it is rudimental, but on the dorsals supports a well-developed articular facet, which meets a corresponding one of the zygantrum. The fixed hypapophyses and roofs of the posterior zygapophyses are rugose, with grooves and ridges. The articular faces of the caudals are broad, vertical ovals as far as the specimens extend; the series including only a part of those with diapophyses. On the anterior caudals, the chevron facets are compressed. The neural spines are thinned out in front, obtuse at the base behind, but expanding to a thin edge above it; the sides longitudinally grooved. Diapophyses on the middles of the sides of the centra. Some ribs have the heads not expanded but truncate. The angle of the mandible is produced backward and below the plane of the lower margin of the ramus in a marked manner. The lower margin and the surface next the smooth edge are rugose.

Measurements.

	M.
Depth of mandible at posterior margin of cotylus	0.058
Length of centrum of anterior cervical	.070
Diameter of the ball, vertical	.028
Diameter of the ball, transverse	.040
Expanse of diapophyses of ball	.095
Expanse of anterior zygapophyses	.064
Expanse of diapophyses of anterior dorsal	.115
Length of centrum of anterior dorsal	.071

	M.
Length of centrum of anterior caudal	.053
Depth of cup of anterior caudal	.044
Width of cup of anterior caudal	.041
Width of neural spine	.033
Elevation of neural spine, (apex lost)	.070
Diameter of centrum of twenty-fourth caudal, vertical	.039
Diameter of centrum of twenty-fourth caudal, transverse	.040
Length of centrum of twenty-fourth caudal	.042

This species appears to have had proportions not unlike those of *Platecarpus coryphæus* the specimen described being larger than that on which the latter is based. It is also rather larger than the *Clidastes planifrons*, the largest of its genus, but which, since its caudal vertebræ are unknown, may be found to be a *Sironectes*. It differs specifically from the *S. anguliferus* in the less development of the zygosphen, especially on the anterior vertebræ, and its deep emarginations in front where well developed. From its general characters I anticipate that the quadrate bone of this species will prove to be more like that of the *Platecarpi;* that of *C. planifrons* is that of the genus to which I have referred it.

PLATECARPUS, Cope.

Extinct Batrachia and Reptilia N. Am., 1869, pp. 185, 199. Proceedings Academy Philadelphia 1872, p. 141; *Holcodus*, Copei *nec* Gibbsii, Proceed. Amer. Philos. Soc. 1871, December; *Lestosaurus*, Marsh, Amer. Journ. Sci. Arts, 1872, June (Separata, p. 9).

Besides the characters assigned to this genus in the analytic table already given, *Platecarpus* is characterized by the form of its teeth, which are neither compressed, as in *Liodon*, nor broadly angularly faceted, as in *Mosasaurus* (and *Holcodus*, *fide* Marsh), but are curved and with subcylindric section. The exposure of the roots of the palatine teeth is largely less or scarcely greater on the outer than on the inner side. The caudal vertebræ of the type-species, *P. tympaniticus*, are unknown; but the quadrate bone and form of palatine teeth are quite similar to those of the other species already referred to it.

The species *P. mudgei* and *P. tectulus* resemble each other in the form of their quadrate bone, and are referred to this genus provisionally only. The *P. simus*, Marsh, resembles the *P. crassartus*, Cope, but appears to differ in the more depressed articular faces of the dorsal vertebræ.

a. The stapedial pit inclosed between ridges:

PLATECARPUS ICTERICUS, Cope; *Holcodus ictericus*, Cope, Proceed. Amer. Philosophical Society 1870, 577, and 1871, December; *Lestosaurus ictericus*, Marsh, Amer. Journ. Sci. Arts, 1872, June.
Niobrara chalk of the Smoky Hill River.

PLATECARPUS CORYPHÆUS, Cope; *Holcodus coryphæus*, Cope, Proceed. Amer. Philos. Society, 1871, December; *Lestosaurus coryphæus*, Marsh, *loc. cit.*

Niobrara chalk of the Smoky Hill River.

PLATECARPUS FELIX, Marsh; *Lestosaurus felix*, Marsh, Amer. Journ. Sci. Arts, 1872, June, tab. xiii, fig. 4.

Niobrara chalk of the Smoky Hill River, Kansas.

Platecarpus curtirostris, Cope; *Liodon curtirostris*, Cope Proceed. Amer. Philos. Soc., 1871, December; *Lestosaurus curtirostris*, Marsh, *loc. cit.*

Niobrara chalk of the Smoky Hill River, Kansas.

aa. Relations of stapedial pit unknown:

Platecarpus crassartus, Cope; *Liodon crassartus*, Cope, Proceed. Amer. Philos. Soc., 1871, 168; and December.

Niobrara chalk of Eagle Tail, Colorado.

Platecarpus simus, Marsh; *Lestosaurus simus*, Marsh, *loc. cit.* 1872, June.

Niobrara chalk of the Smoky Hill River.

Platecarpus latifrons, Marsh; *Lestosaurus latifrons*, Marsh, *loc. cit.* 1872, June.

Niobrara chalk of the Smoky Hill River, Kansas.

Platecarpus gracilis, Marsh; *Lestosaurus gracilis*, Marsh, *loc. cit.*, 1872, June.

Niobrara chalk of the Smoky Hill River, Kansas.

Platecarpus (?) glandiferus, Cope; *Liodon glandiferus*, Cope, Proceed. Amer. Philos. Society, 1871, December.

Niobrara beds of the Smoky Hill, Kansas.

aaa. Stapedial pit excavated in a plane surface:

Platecarpus mudgei, Cope; *Liodon mudgei*, Cope, Proceed. Amer. Philosophical Soc., 1870, p. 581; *Holcodus mudgei*, Cope, *loc cit.* 1871, December; *Rhinosaurus mudgei*, Marsh, American Journ. Sci. Arts, 1872, June.

Niobrara chalk of the Smoky Hill River.

Platecarpus tectulus, Cope; *Holcodus tectulus*, Proceed. Amer. Philos. Soc., 1871, December.

Niobrara chalk of the Smoky Hill River.

LIODON, Owen.

Proceedings British Assoc. Advancement of Science, 1841, p. 144; Cope, Transac. Amer. Philosophical Society, Extinct Batrachia, etc., 1870, p. 200; Proceedings Amer. Philos. Society, 1871, December.

The typical species of this genus, *Liodon anceps*, Owen, is very little known, but few remains having so far been obtained from the English chalk, its locality and horizon. Numerous North American species resemble it in the forms of the crowns of the teeth, and it is probable, though not certain, that they agree in other respects also. Several names have been proposed for our species; the earliest of which is *Macrosaurus*, Owen. This name applies to species with compressed dorsal vertebræ as *L. lævis* and *L. mitchillii*, both from the New Jersey greensand. For the species with depressed dorsal vertebræ, as *L. validus*

from New Jersey, *L. perlatus* from Alabama, and *L. proriger* from Kansas, the name *Nectoportheus* was proposed, and briefly characterized (Extinct Batr. Reptilia N. America, 1870, p. 208.) Prof. Marsh subsequently gave the Kansas species the name of *Rhinosaurus*; which name being pre-occupied more than once, I changed it to *Rhamphosaurus*.* This name will remain for species of the type of *Liodon proriger*, if they be found to represent a genus distinct from *Nectoportheus* or *Liodon*, of which there is as yet no evidence.

LIODON MICROMUS, Marsh; *Rhinosaurus micromus*, Marsh Amer. Journ. Sci. Arts, 1872, June, tab. xiii, figs. 1–2.

Niobrara chalk of the Smoky Hill.

LIODON NEPÆOLICUS, *sp. nov.*

Rhamphosaurus nepæolicus, Cope, MSS.

Represented by the mandibular and parts of the maxillary and premaxillary bones, the quadrate, a dorsal vertebra, &c., of a single individual. These all indicate an animal related to the large *L. proriger*, but not more than one-third the size or less. It is about the same size as the *L. micromus*, Marsh, but is much more like the *L. proriger* in characters, so as to render it important to ascertain whether it be not a young individual of that species. An examination having convinced me that such is not the case, the points of distinction will be given further on.

The *premaxillary* is very prominent, forming a rostrum whose inferior face is narrowed below, and then suddenly descends to a prominent transverse ridge, which bounds the anterior alveoli in front. The four premaxillary teeth stand on an area a little broader than long. Extremity broken. The anterior suture of the *maxillary* is vertical and zigzag. It displays a lateral contraction just behind the first tooth, while the anterior margin of the nostril is above the third tooth. The teeth of both jaws have broadly oval bases, and apices with two cutting edges and lenticular section. The inner face is more convex than the outer, most so in the anterior part of the jaws, and neither is facetted. The enamel is finely striate-grooved, especially toward the base. The mandible is light and thin, and diminishes in depth posteriorly. The coronoid is small, and the angle is produced backward, and but little downward. The rami are not complete; the large portions preserved exhibit teeth at intervals of precisely an inch. Professor Mudge, who discovered the specimen, states that the jaw, when together, measured 26 inches in length, which would leave 13 inches for the dentary bone. This is, therefore, not far from the true number of teeth.

The *quadrate* resembles that of *L. dyspelor* in various respects. The internal longitudinal ridge is very prominent, and extends from the proximal angle to the distal articular face, in line with the plane of the short acuminate hook. The great ala is narrow and rather stout; the proximal articular face slopes steeply outward. The stapedial pit is a narrow straight groove (perhaps partly closed by pressure). The knob is represented by a longitudinal crest bordering the meatus below on the outer side, and not continuing to the distal articulation. The sur-

* This name was applied by Fitzinger to two species of lizards, which had already received several generic names, and hence became at once a synonym. Further, he did not characterize it; for these reasons the name was not preoccupied at the time I employed it as above; hence there is no necessity for Prof. Marsh's subsequent name *Tylosaurus*, given on the supposition of preoccupation.

face of the latter is crescentic, with an angle on the outer anterior border. This angle is the summit of a short low rugose ridge, which extends part way to the knob. Outer edge only of the great ala radiate grooved; posterior angle of distal condyle produced.

The *dorsal vertebra* is somewhat flattened by pressure; but the bal-was evidently transversely cordate in outline. The bases of the dial pophyses are very rugose; an acute angle from the articular cartilage is directed toward it from the rim of the cup. Inferior face with an obtuse median keel. The *odontoid* bone is deeper than long (fore and aft).

As compared with *L. micromus*, this species differs in the much less attenuated premaxillary and maxillary bones, the anterior nostril, and absence of facets on the crowns of the teeth; from *L. proriger* in the absence of narrow concave facets on the anterior teeth, and anterior position of the nostril; from *L. dyspelor* in the less compressed or less knife-shaped dental crowns, and totally different form of the condyle of the quadrate.

Measurements.

	M.
Length of bases of two premaxillary teeth	0.026
Width of bases of two premaxillary teeth	.034
Length of bases of two maxillary teeth	.042
Depth of anterior suture of maxillary teeth	.028
Depth of maxillary at end of nares	.038
Length of quadrate	.082
Length of distal condyle	.040
Width of distal condyle	.017
Width of great ala on inner side	.032
Width of inner face above meatus	.037
Length of hook from stapedial pit	.028
Length of a dorsal vertebra	.059
Diameter of ball, vertical	.029
Diameter of ball, transverse	.048

This species was discovered by Prof. B. F. Mudge, who dug the type specimen from the gray shale of the Niobrara Cretaceous, a half mile south of the Solomon River, Kansas.

LIODON LATISPINUS, Cope, Proceed. Am. Philosoph. Society, 1871, 169, and December.

North Fork of Smoky Hill and Trego County, Kansas.

LIODON PRORIGER, Cope, Transac. Amer. Philosophical Soc., Extinct Batrachia, &c., 1870, 202; *Macrosaurus proriger*, *loc. cit*, on tab. xii, figs. 22–24; *Rhinosaurus proriger*, Marsh, Amer. Journal Sci. Arts, 1872, June; *Rhamphosaurus*, Cope, Proceed. Acad. Nat. Sci., 1872, 141.

Niobrara chalk of the region of the Smoky Hill River, Kansas.

LIODON DYSPELOR, Cope, Proceed. Amer. Philosoph. Soc. 1870, 574; *loc. cit.*, 1871, December; *Rhinosaurus dyspelor*, Marsh Am. Jour. Sci-Arts, 1872, 1872, June; *Tylosaurus dyspelor*, Leidy, Report of Geolog. Survey of Terrs., I, 271, tab. xxxv, figs. 1–11.

Niobrara chalk of Fort McRae, N. Mex.; Niobrara chalk of Smoky Hill, Kansas.

PISCES.

? SYNENTOGNATHI.

PELECORAPIS, Cope, *gen. nov.*

This genus embraces fishes with strongly ctenoid scales and abdominal ventral fins; there is a spinous dorsal fin apparently short, and not continued over the ventrals. The ribs and apophyses are slender, and the dorsal vertebræ short and pitted. The pubic bones consist of two antero-posterior plates, in contact on the middle line. The anterior portion projects to a median angle, and there is an angular projection of the lateral border. From the angle formed by these borders, a long cylindric rod projects forward; those of opposite sides slightly converging.

The general relations of this form are to the families which combine the features of the orders of physoclystous and physostomous fishes, namely, *Scombresocidæ*, *Atherinidæ*, &c. The pelvis has considerable resemblance to that of those families, but especially to that of *Exocœtus*. From this it presents subordinate differences.

PELECORAPIS VARIUS, *sp. nov.*

Represented by portions of perhaps two individuals, the larger of which includes a considerable part of the body, the head and tail being absent. On this specimen it is evident that the scales diminish in size toward the posterior part of the body, where they are small; on the anterior region there are two scales exposed in an oblique series, in 6 millimeters; on the posterior region, $3\frac{1}{2}$ and 4 in the same. The concealed portions of the scale are sculptured with minute contiguous concentric grooves, without any radii. The exposed portion is thickened with a cementum-like layer, which is marked with a few radiating lines of pores which sometimes unite into an irregular groove. Teeth of the comb numerous and strong. Depth of body at pelvis, $0^{m}.074$; length of pelvis, $0^{m}.040$; of lamina, $0^{m}.022$; of rod, $0^{m}.022$; greatest width of pelvis, $0^{m}.023$; width at basis of rods, $0^{m}.014$; length of 17 consecutive vertebræ, $1^{m}.05$; diameter of a dorsal vertebra, $0^{m}.007$.

Discovered by Professor Mudge in a lead-colored clay, probably of the Benton epoch, 20 feet below the *Inoceramus* bed, 2 miles west of Sibley, Kansas.

ISOSPONDYLI.

PORTHEUS, Cope.

Proceed. Amer. Philos. Soc., 1871, 173; *loc. cit.*, 1872, 331.

Additional material establishes as correct the reference of sharp-edged compound rays to the pectoral fins, and narrower, simple ones to the ventrals; while the presence of a frontoparietal fontanelle is doubtful. The number of teeth in the premaxillary bone is subject to some variation, there being occasionally, besides the principal ones, a small accessory on one or both sides.

PORTHEUS MOLOSSUS, Cope, Proceed. Amer. Philos. Soc., 1871, 173; 1872, 333.

Common in the Niobrara Cretacious of the Smoky Hill region, Kansas.

PORTHEUS THAUMAS, Cope; *Saurocephalus thaumas*, Cope, Proceed. Amer. Philos. Soc., 1870, November; *loc. cit.*, 1872, 335.

Same locality as the last.

PORTHEUS LESTRIO, Cope, Proceed. Academy Natural Sciences, Philadelphia, 1873, 337.

Niobrara Cretaceous of Kansas near the Solomon River; abundant.

PORTHEUS MUDGEI, *Sp. nov.*

Represented by portions of the jaws with vertebræ of a single individual discovered by Prof. B. F. Mudge, in Trego County, Kansas. The prominent character is seen in the possession of four subequal teeth in the premaxillary bone, which therefore presents a relatively long alveolar border for their accommodation. The bone is also more massive than in the other species, and is peculiarly thick on the free inner edge. There are five or six subequal large teeth behind an edentulous space on the maxillary bone, while those on the posterior part are small. The specimen is smaller than is usual in other species of the genus.

Measurements.

	M.
Width of premaxillary bone	0 .054
Elevation of premaxillary bone above first tooth	.060
Thickness of premaxillary bone at middle	.021
Depth of maxillary at condyle	.057
Depth of maxillary at fifth large tooth	.040
Length of basis of five large teeth	.036
Length of an anterior vertebra	.019
Diameter, vertical	.031
Diameter, transverse	.031

Occasionally the *Portheus lestrio* exhibits one or even two minute additional premaxillary teeth, but the three large teeth always remain a distinction from the four large ones of the *P. mudgei*.

PORTHEUS GLADIUS, Cope, Proceed. Acad. Nat. Sci. Philadelphia, 1873, 338.

Represented by a huge pectoral spine, which may belong to one of the preceding species.

Niobrara Cretaceous of the Solomon River, Kansas.

ICHTHYODECTES, Cope.

Proceed. Amer. Philos. Society, 1870, November; *loc. cit.*, 1872, 338.

ICHTHYODECTES ANAIDES, Cope, *loc. cit.*, 1872, 339.

Niobrara Cretaceous of the Smoky Hill.

ICHTHYODECTES CTENODON, Cope, *loc. cit.*, 1870, November; *loc. cit.*, 1872, 340.

Niobrara Cretaceous of the Smoky Hill.

ICHTHYODECTES HAMATUS, Cope, *loc. cit.*, 1872, 340.

Niobrara Cretaceous of the Smoky Hill.

ICHTHYODECTES PROGNATHUS, Cope, *loc. cit.*, 1872, 341; *Saurocephalus prognathus*, Proceed. Amer. Philos. Soc., 1870, November.

Niobrara Cretaceous of the Smoky Hill.

ICHTHYODECTES MULTIDENTATUS, Cope, *loc. cit.*, 1872, 342.
Niobrara Cretaceous of the Smoky Hill.

ICHTHYODECTES PERNICIOSUS, *sp. nov.*

Compound pectoral spines of this genus, which have heretofore come under my observation in considerable abundance, exhibit an undulating cutting margin with low waves, and a nearly uniform thickness. These I have attributed to such species as *I. anaides*, *I. ctenodon*, and *I. hamatus.* A spine pertaining to a fish of equal or greater size than these has been several times obtained, which evidently belongs to another and more formidably-armed species.

The cutting edge is coarsely serrate, each projecting tooth marking the end of one of the oblique component rods. The apex of each tooth is the end of a transverse thickening or low ridge of the surface of the spine, so that the cutting edge is equally acute at the bottoms of the concavities as at the rather obtuse apices of the teeth. The cement or enamel layer extends on both sides of the spine 0.75 inch from the cutting edge; it is composed of small aggregated tubercles. Length of fragment supporting twenty teeth, $0^{m}.235$; thickness of fragment at middle, $0^{m}.008$. Discovered by Professor Mudge.

DAPTINUS, Cope.

Proceedings Academy Philadelphia, 1873, 339.

DAPTINUS PHLEBOTOMUS, Cope; *Saurocephalus phlebotomus*, Cope, Proceed. Amer. Philos. Soc., 1870, November; Hayden's Annual Rept. U. S. Geol. Surv., 1871, 416.

Niobrara epoch, Rooks and Phillips Counties, Kansas.

SAUROCEPHALUS, Harlan.

SAUROCEPHALUS LANCIFORMIS, Harlan, Journal Academy Natural Sciences, I vol. iii, 331; Leidy, Transac. Amer. Philosophical Soc., 1860.

Cretaceous on the Missouri River.

SAUROCEPHALUS ARAPAHOVIUS, Cope, Proceed. Amer. Philos. Soc., 1872, 343.
Niobrara epoch of the Smoky Hill, Kansas.

ERISICHTHE, Cope.

Proceedings Academy Philadelphia, 1872, 280.

In this genus the teeth are implanted in deep sockets as in other *Saurodontidæ*, and the subalveolar line of foramina seen in *Saurocephalus* is wanting. The crowns of the teeth are compressed and knife-like as in *Daptinus*, but those of the anterior parts of the dentary and maxillary bones are greatly enlarged. Maxillary bone short and rapidly tapering to a narrow edentulous extremity. Greater part of the dentary with a rugose band on the inner side of the teeth; its distal portion with a row of small compressed teeth separating the large teeth into two areas.

ERISICHTHE NITIDA, Cope, *loc. cit.*

Represented by numerous portions of a cranium with a fragment of a pectoral ray discovered by Prof. B. F. Mudge near the Solomon River, Kansas. The ray is of the compound character already described as belonging to other genera of this family; its edge is not preserved.

The *maxillary* bones are subtriangular in form, and support three or four large lancet-shaped teeth at the middle of their length; there are no teeth beyond them, but on the deeper side there are several small lancet-shaped teeth; the outer alveolar edge is rugose. The teeth are very flat, acute, and perfectly smooth. The teeth on the greater part of the dentary are intermediate in size between the large and small ones of the maxillaries; they stand on the outer edge of a broad horizontal alveolar plane. There are three large teeth in a series at the end of the dentary on the outer side; they have been lost, but their bases are broader ovals than those of the maxillary bone. On the middle line of this part of the dentary is a close series of small compressed teeth, with striate enamel, standing on a ridge of the bone. They leave the last large tooth to the outer side, while on the inner side stand two or three lancet-shaped tusks of a short row further back. Posterior dentaries $0^{mm}.10$ apart.

Measurements.

	M.
Length of maxilary bone above	0.0880
Depth proximally	.0300
Length of crown of a large tooth	.0150
Width of crown at base	.0065
Length of hyomandibular	.1000

Niobrara epoch of Phillips County, Kansas. Discovered by Prof. B. F. Mudge.

PACHYRHIZODUS, Agass.

Dixon's Geology of Sussex, 1850, 374; Cope, Proceed. Amer. Philos. Soc., 1871, 344.

PACHYRHIZODUS CANINUS, Cope, *loc. cit.*, 344.

Niobrara epoch of the Smoky Hill River.

PACHYRHIZODUS KINGII, Cope, *loc. cit.*, 346.

Niobrara epoch of the Smoky Hill River.

PACHYRHIZODUS LATIMENTUM, Cope, *loc. cit.*, 346.

Niobrara epoch of the Smoky Hill.

PACHYRHIZODUS LEPTOPSIS, *sp. nov.*

Represented by portions of the right and left dentary bones, with other portions of the cranium. The symphyseal part of the ramus is not incurved, as in *P. caninus* and *P. kingii*, but is obliquely truncate, indicating that the chin had a compressed form, and was not rounded, as in them. The lower portion of the bone is thin and laminiform to a deep groove, which extends from the edge of the symphyseal face along the inner side at one-third the depth of the ramus from the inner bases of the roots of the teeth. The latter are thus supported on a

thickened basis. They are rather remote in a functional condition, each interspace being entirely occupied by the alveolar fossa of the shed tooth. These bases are very stout and composed of dense bone; their apices rise a little above the edge of the external alveolar border. The bases of the crowns are oval, and they display an anterior cutting edge, which descends from the apex, thus differing materially from those of the *P. caninus*. The teeth diminish in size from the middle of the dentary bone to the symphysis; beside the latter are two teeth of reduced size. The outer face of the dentary is smooth, except some small impressed fossæ. The mental foramina are small and do not issue in a groove. Below them, on the outer face, is a fossa, with level floor to the inferior margin.

Measurements.

	M.
Length of margin bearing four teeth	0.050
Depth of ramus at third tooth	.025
Elevation of tooth basis	.008
Long diameter base of crown of ditto	.006

Niobrara epoch of Phillips County, Kansas.

PACHYRHIZODUS SHEARERI Cope, Proceed. Amer. Philos. Society, 1872, p. 347.

Niobrara epoch of the Smoky Hill River.

PHASGANODUS, Leidy.

PHASGANODUS DIRUS, Leidy, Proceed. Acad. Nat. Sciences, Philada., 1857, 167; Report Geolog. Survey Terrs. 1873, I, 289; tab. xvii, figs. 23, 24.

From Cannon Ball River, Dakota.

PHASGANODUS (?) GLADIOLUS, Cope; *Cimolichthys gladiolus*, Cope, Proceed. Amer. Philos. Soc., 1872, 353.

Niobrara epoch of the Smoky Hill River.

TETHEODUS, Cope, *gen. nov.*

Premaxillary bone a petrous mass without teeth; the maxillary with teeth in a single row, the anterior much enlarged; dentary with a single series, one anterior tooth much enlarged. Apices of teeth with trenchant edges.

A genus chiefly differing from *Enchodus* in the absence of the large tooth at the extremity of the premaxillary bone.

TETHEODUS PEPHREDO, *sp. nov.*

Both premaxillary and portions of the maxillary and dentary bones of one specimen represent this species. They show it to have been a powerful fish of the size of the *Enchodus petrosus* below mentioned. The premaxillaries are excavated by the usual three oblique fossæ above to the inner side. The alveolar face is a ridge extending obliquely across from a tuberosity on the inner side behind the apical tuberosity. There is no surface for the attachment of a tooth, and no scar or other trace of the former existence of one. The maxillary underlaps it by an oblique suture, and supports a large tooth similar to that at the end of the premaxillary in *Enchodus*, behind which are seen the crescentic scars of the previously-shed teeth. The outer face of the basal cementum of this tooth

is perfectly smooth. The distal portion of the *dentary* bone is toothless; its anterior tooth is a fang with base excavated in front; and an angle rising from the external side of it becomes a latero-exterior cutting edge of the crown to the apex. The inner posterior, or more convex face, of the tooth is regularly and closely striate-grooved. On one dentary there are three or four small denticles in front of it on the outer side. The smaller teeth have two cutting edges, and the posterior face at the base is grooved striate. This regular grooving, as well as the large size of the first maxillary, distinguishes this fish from the *Enchodus anceps*.

Measurements.

	M.
Length of premaxillary bone above	0.075
Depth of premaxillary	.033
Width of basis first maxillary tooth	.010
Length of dentary at first tooth	.020
Length of dentary to first tooth	.020
Length of first tooth	.032
Interval between maxillary teeth	.008

Niobrara epoch of Phillips County, Kansas; discovered by Prof. B. F. Mudge.

ENCHODUS, Agass.

ENCHODUS PETROSUS, *sp. nov.*

Established on the maxillary and premaxillary bones, of both sides of the same individual. In the latter bone the anterior margin is truncate obliquely upward and backward, its lower margin passing into the base of the single large tooth; alveolar surface elongate, posteriorly narrowed to an obtuse edge. The maxillary exhibits both borders obliquely truncate, with sutural face. The alveolar aspect supports two teeth, one larger than the other.

The premaxillaries are very massive, and exhibit on their upper faces three oblique fossæ, the posterior transversely subdivided. External face smooth.

Measurements.

	M.
Length of premaxillary, (distal end lost)	0.067
Greatest width of alveolar face	.018
Depth of outer face	.030
Diameter at basis of tooth	.009

Obtained by Professor Mudge from beds of the Niobrara epoch in Kansas.

ENCHODUS (?) ANCEPS, Cope; *Cimolichthys anceps*, Cope, Proceed. Amer. Philos. Society, 1872, 552.

Niobrara epoch of the Smoky Hill River.

ENCHODUS CALLIODON, Cope, *loc. cit*, 354.

Niobrara epoch of the Smoky Hill River.

ENCHODUS SHUMARDII, Leidy, Proceed. Acad. Nat. Sciences Philadelphia, 1856, 257; Report U. S. Geol. Survey Terrs., I, 1873, 287, tab. xvii, fig. 20 Sage Creek, Dakota.

EMPO, Cope.

Proceed. Amer. Philosophical Soc., 1872, 347; *Cimolichthys*, Cope, *loc. cit.*, 348, (attributed to Leidy, but not his genus).

A large number of additional specimens have been examined since the description above cited was published; as several of these embrace crania with the bones in place, and greater or less portions of the bodies, many important additions to the definition can be made.

The anterior end of the maxillary is subconic and generally compressed, as originally described under *E. semianceps*, and free from well-marked sutural surface. The distal part of the bone has a greater vertical extent, and exhibits points of attachment for bones or ligaments. This relation, the reverse of what might be supposed without violating analogy, I have proved on two crania where they are in place. I have only seen the premaxillary in one species, the *E. semianceps*. It resembles that of *Enchodus* in its solid, massive character, and the presence of a prominent tooth at the anterior extremity. It bears two teeth near the middle of its length, a character which may be specific only. At the anterior extremity of the maxillary, there is a short series of large teeth, which continues gradually or abruptly into a series of much smaller teeth along the inner or posterior border of the alveolar face. This terminates in one or two abruptly larger teeth near the distal end of the bone. The outer alveolar border is occupied by a row of teeth of large size, similar to those at the proximal end, which commences opposite the most distal of the latter. Their size is reduced opposite to the two large distal ones, and is recovered again in the single row on the narrowed distal portion of the maxillary. The teeth are compressed at the tip, and generally bear one or more cutting edges.

The *dentaries* support several series of teeth, one of large ones on the inner side, and several smaller on the outer. The small ones are double-edged, and diminish in size to the external margin; the inner ones are like the large ones of the maxillary series, with a flattened cutting apex.

There are other tooth-bearing bones, which I cannot positively locate. Some of these are laminiform, and are covered on one edge and for some distance on the adjacent sides with a dense brush of small acute conic teeth. This bone is palatine or pterygoid. Another is a massive tongue-shaped bone with one narrowed extremity and the other expanded into a lamina in the same plane. It supports a median series of teeth mostly in two rows, whose crowns are curved and simply conic. This bone is sometimes nearly symmetrical, so as to resemble a vomer; but in others it is distinctly unsymmetrical, and hence probably a lateral element. In one specimen it lies pressed down on the dentary with the teeth on the inferior side. Another bone is rod-like, with triangular section, with a single row of small conic teeth set on the edge, whose section gives an angle. This, doubtless, belongs to the branchihyal system, to which, perhaps, the piece first described may be attached. The latter I call the *pharyngeal* bone until fully identified.

The *vertebræ* are not grooved as in *Saurodontidæ*, but sculptured with raised lines only on the greater part of the column. Posteriorly deep lateral grooves appear. The ribs are well developed, and the abdominal cavity not elongate. Ventral fins are not in the abdominal position in the best identified specimens of *E. sulcata*. No strong fin-rays can be certainly referred to the genus. The body was covered with very large scales on the side and on the middle line of the back; some of the latter having the character of shields. They have the surface, in some spe-

cies, marked with raised radiating ribs, or inosculating ridges, whose edges are sometimes serrate.

Several species of this genus appear to have existed. I originally referred some of them to Dr. Leidy's genus *Cimolichthys;* but I find that they do not possess the same type of teeth. The *Empo nepaeolica* probably belongs to it, and the generic characters formerly given express the peculiarities of dentition of the distal part of the maxillary bone. The genus therefore takes this name. From several allied genera here enumerated, it differs in the presence of the outer series of small teeth on the dentary bone, and the inner series of the maxillary, with the absence of long teeth on the front of the former.

EMPO NEPAEOLICA, Cope, Proceed. Amer. Philosophical Soc., 1872, 347.

Niobrara epoch of the Smoky Hill region.

EMPO SULCATA, Cope; *Cimolichthys sulcatus*, Cope, *loc. cit.*, 351.

Niobrara epoch of the Smoky Hill and of Rooks County, Kansas.

EMPO SEMIANCEPS, Cope; *Cimolichthys semianceps*, Cope, *loc. cit.*, 351.

Niobrara epoch of the Smoky Hill region, and of Trego and Rooks Counties, Kansas.

EMPO MERRILLII, *sp. nov.*

Indicated by numerous portions of cranial bones, including those supporting the teeth. On the proximal part of the maxillary, the large teeth grade into those of the small inner series insensibly; at the distal end the two large ones of the inner side are opposite to the reduced ones of the outer series. Both maxillary and mandibular teeth are striate-grooved on the outer side at the base. The pharyngeal bone is peculiar in not bring widely expanded at one end, and in having a narrow basis generally for the two rows of teeth it supports. The (?) palatine bone exhibits the teeth *en brosse*, seen in *E. semianceps*, but principally on one side, and the thickened edge supports on one of its marginal angles a series of much larger conical teeth.

Measurements.

	M.
Width of maxillary inferiorly at middle	0.012
Depth of maxillary distally	.018
Depth of maxillary proximally	.011
Depth of (?) palatine	.018
Width of pharyngeal bone at middle	.009

Niobrara epoch of Ellis County, Kansas. Dedicated to Professor Merrill, of Topeka, who has made a number of important additions to our knowledge of the extinct vertebrata of Kansas.

EMPO CONTRACTA, *sp. nov.*

Considerable portions of a cranium of a species of the lesser size of the *E. semianceps* resemble corresponding parts of that species, with certain marked exceptions. These are seen in the flatness of the maxillary bone, and the large size of the inner row of teeth. The inner face of the maxillary is very narrow, by reason of the depression of form. The proximal end of the same is, on the other hand, a little compressed.

A single row of large teeth occupies it, extending along the inner alveolar border; those of the outer row appear to be wanting for a considerable distance, and are at first no larger than those of the outer. On the outer face at the distal end the usual fossa on the upper half is wanting, the face from the alveolus being continuous with that of the rising lamina. The pharyngeal bone is flat and expanded behind. The dentary is acuminate distally, and the mental foramen issues in a groove, which passes around the end. The inferior external fossa commences some distance behind the foramen. External face of dentary striate.

Measurements:

	M.
Length of maxillary (constructed from fragments from opposite sides)	0.118
Width below at middle	.011
Depth of inner face	.004
Depth of outer face	.011
Length of bases of five proximal teeth	.027
Width of pharyngeal bone at middle	.010
Depth of dentary 2^{mm} from end	.012

From the Niobrara epoch of Trego County, Kansas. Discovered by Prof. B. F. Mudge, of the State Agricultural College of Kansas.

STRATODUS, Cope.

Proceed. Amer. Philosoph. Society, 1872, 348.

STRATODUS APICALIS, Cope, *loc. cit.*, 349.

Niobrara epoch of the Smoky Hill River.

APSOPELIX, Cope.

Hayden's Annual Report, 1870, 423.

APSOPELIX SAURIFORMIS, Cope, *loc. cit.*, 1870, 424.

Benton epoch at Bunker Hill, Kansas.

SELACHII.

SPORETODUS, Cope. *Gen. nov.*

Established on teeth resembling the posterior or pavement teeth of *Heterodontus*. Their arrangement cannot be described, as they are only known by separated specimens. Their surface is regularly convex, and covered with a dense layer, which does not exhibit pores, and is thrown into transverse or oblique ridges. No root is preserved in the specimens, but the basis is coarsely porous.

SPORETODUS JANEVAII, *sp. nov.*

A small tooth, probably lateral, is an oval, with its surface thrown into four folds, which traverse it obliquely from border to border. At the base of the outer at one end is a series of adherent tubercles; at the basis of that at the opposite end is a broken fold, with tubercles at its outer base. Length, $0^{m}.0045$; width, $0^{m}.0025$. A portion of a larger and more central tooth has the surface with an unsymmetrical convexity, and crossed transversely by five folds.

Discovered by Prof. B. F. Mudge, near Stockton, Kansas, in a bed containing many teeth of *Oxyrhina*, *Lamna*, &c., of small size. Dedicated to Dr. John H. Janeway, post-surgeon at Fort Hays, Kansas, who has rendered much important aid to palaeontology and zoölogy in Kansas.

PTYCHODUS, Agass.

PTYCHODUS POLYGYRUS, Agass., Poiss. Foss.

Niobrara epoch, Ellis County, Kansas; Professor Mudge and Professor Merrill.

PTYCHODUS OCCIDENTALIS, Leidy, Proceed. Academy Philadelphia, 1868, 207; Report Geolog. Surv. Terrs., 1873, 398; tab. xvii, 7–8, xviii, 15–18.

Niobrara epoch of the Smoky Hill.

PTYCHODUS MORTONII, Agass. Poiss. Foss.

Niobrara Cretaceous of the Smoky Hill River; Prof. Mudge.

PTYCHODUS WHIPPLEYI, Marcou, Geol. North America, 1858, 33; Leidy, Report, etc, 1873, 300, tab. xviii, 19–20.

Niobrara epoch of the Arkansas River, Kansas, and Galisteo, New Mexico; Professor Merrill.

GALEOCERDO, M. H.

GALEOCERDO CRASSIDENS, Cope, Proceed. Amer. Philos. Soc., 1872, 355.

Niobrara epoch of the Smoky Hill.

GALEOCERDO HARTVELLII, Cope, *loc. cit.*, 1872, 356.

Niobrara Epoch of the Smoky Hill.

GALEOCERDO FALCATUS, Agass., Leidy, Report U. S. Geol. Survey Terrs., I, 301; tab. xviii, 29–43.

Niobrara epoch of the Smoky Hill.

OTODUS, Agass.

OTODUS DIVARICATUS, Leidy, Report, I, 305; tab. xviii, f. 26–28.

Represented by several teeth, of which I select the largest and most perfect as type. The lateral denticles are well developed, though not large. The median cusp is rather narrow and moderately curved antero-posteriorly. The posterior surface is smooth, the anterior coarsely striate at the base. The fangs of the root diverge strongly, but, what constitutes a peculiarity of the species, project far forward and outward at their point of junction below the crown, reminding one of the outline of the Hottentot Venus.

Jewell County, Kansas; Professor Mudge.

OXYRHINA, Agass.

OXYRHINA EXTENTA, Leidy, *loc. cit.* 302; tab. xviii, 23–25.

Niobrara Epoch of the Smoky Hill.

LAMNA, Cuv.

LAMNA, two sp., Leidy, *loc. cit.*, p. 304.

SUPPLEMENTARY NOTICES

OF

FISHES FROM THE FRESHWATER TERTIARIES OF THE ROCKY MOUNTAINS.

RHINEASTES, Cope.

Hayden's Annual Report, 1872, 638.

RHINEASTES PECTINATUS, *sp. nov.*

This catfish is represented by a single specimen, which includes only the inferior view of the head and body anterior to the ventral fins. These exhibit characters similar in many respects to those of *Amiurus*, Raf.; but the introperculum, the only lateral cranial bone visible, displays the dermoössified or sculptured surface of the Eocene genus, to which I now refer it. Other characters are those of the same genus. Thus the teeth are brush-like, and there is an inferior limb of the post-temporal bone reaching the basi-occipital. The modified vertebral mass is deeply grooved below, and gives off the enlarged diapophysis that extends outward and forward to the upper extremity of the clavicle. The patches of teeth on the premaxillary are separated by a slight notch at the middle of the front margin. The teeth are minute. The four basihyals and the elongate anterior axial hyal are distinct; also the ceratohyal with its interlocking median suture. The number of branchiostegal radii is not determinable; there large ones are visible. The mutual sutures of the clavicles and coracoids are interlocking, and their inferior surface displays grooves extending from the notches. The pectoral spine is rather small, and bears a row of recurved hooks on its posterior face; there are none on the anterior face.

The head is broad, short, and rounded in front, which, with the uncinate character of the serration of the pectoral spine, reminds one of the existing genus *Noturus*. As compared with the five species of *Rhineastes*, described from the Bridger Eocene, the present species is distinguished by the small size and large uncini of the pectoral spine.

Measurements.

	M.
Length of head to clavicle (below)	0.0180
Width of head (below)	.0360
Width of scapular arch (below)	.0110
Expanse of modified diapophyses	.0200
Length of modified vertebræ	.0115
Length of pectoral spine	.0210

From the Tertiary shale of the South Park, Colorado.

AMYZON, Cope.

Hayden's Annual Report, 1872, 642.

AMYZON COMMUNE, *sp. nov.*

In describing this species, the following additions to our knowledge of the generic characters may be made. There is an open fronto-parietal fontanelle; the premaxillary forms the entire superior arch of the mouth; the pharyngeal bones are expanded behind; there are 12 to 13 rays of the ventral fin; there is a lateral line of pores, which divides the scales it pierces to the margin.

The greatest depth of the body is just anterior to the dorsal fin, and enters the length 2.66 times to the base of the caudal fin, or a little more than three times, including the caudal fin. The length of the head enters the former distance a little over 3.25 times. The general form is thus stout and the head short; the front is gently convex, and the mouth terminal. There are fifteen or sixteen rows of scales between the bases of the dorsal and ventral fins. They are marked by close concentric lines, which are interrupted by the radii, of which eight to fifteen cross them on the exposed surface, forming an elegant pattern. At the center of the scale the inturrupted lines inclose an areolation. The extended pectoral fin reaches the ventral or nearly so; the latter originates beneath the anterior rays of the dorsal, or in some specimens a little behind that point. They do not reach the anal when appressed. The anal is rather short, and has long anterior radii. The dorsal is elevated in front, the first ray being a little nearer the basis of the caudal fin than the end of the muzzle. Its median and posterior rays are much shortened; the latter are continued to near the base of the anal fin. Radii, D. 33; P. 14; V. 13; A. 12. The caudal is strongly emarginate and displays equal lobes.

Measurements.

	M.
Length of a large specimen (10.25 inches)	0.250
Length of a medium specimen	.182
Depth at occiput	.043
Depth at dorsal fin	.057
Depth at caudal peduncle	.023
Length of head, axial	.044
Length to D. 1, axial	.075
Length to end of dorsal, axial	.131
Length to basis of caudal fin	.146
Length of basis of anal fin	.023

There are 38 or 39 vertebræ, of which 9 are anterior to the first interneural spine, and 14 between that point and the first caudal vertebra.

A very large number of specimens was obtained by Dr. Hayden and myself from the Tertiary shales of the Middle and South Parks, Colorado. They display but insignificant variations in all respects, and furnish a good basis of determination. They all differ from the *A. mentale* (Cope, Proceed. Amer. Philos. Soc., 1872, 481) in the larger numbers of vertebræ and dorsal and anal fin radii, and greater prolongation of the dorsal fin. It is, however, nearly allied to the species of the Osino shales. The only fish found associated with this one is the small nematognath just described. The predominance of these types and exclusion of the brackish-water genera *Asineops*, *Erismatopterus*, and *Clupea*, so abundant in the shales of the Green River epoch, indicate a more lacustrine, and hence, perhaps, though not necessarily, later deposit.

CLUPEA, Linn.

CLUPEA THETA, *sp. nov.*

Represented by a specimen from the Green River shales near the mouth of Labarge Creek, in the upper valley of Green River. It is a larger species than the *C.* humilis, Leidy, which is also found at the same locality, and it has a much longer anal fin. Its radii number 26, possibly a few more, as the end appears to have been injured. The dorsal fin is short; the last ray in advance of the line of the first of the anal. The body is deep. Number of vertebræ from the first interneural spine to the last interhæmal, 29. Depth at first dorsal ray, 0.0485; depth at last anal ray, 0.0170; length of 29 vertebræ, 0.0780.

ON THE GENERAL CHARACTERS AND THE RELATION OF THE FLORA OF THE DAKOTA GROUP.*

BY LEO LESQUERUEX.

The present article is a *résumé* of the essential characters and the relation of the flora of the Dakota group.

1. Though the Cretaceous formation containing our fossil leaves has been recognized as marine, from the presence in its compounds of a number of species of marine mollusks, no trace of fucoidal plants has been found among the vegetable remains of this group. The one described as *Zonarites* comes from the Benton group, where it was discovered in a kind of limestone, mostly composed of large marine shells, species of deep water.

It has been remarked how the fucoidal vegetation could not be introduced or brought upon the mud-flats and mixed with the red shale of the Dakota group, though the remains of marine plants are found in abundance just at the top of the Cretaceous series, in the lower sandstone of the Tertiary, which, on this account, has been compared to the Eocene, and admitted as its representative. This fact rather confirms the opinion that the Dakota formation is the result of a slow agglomeration of materials along a shore-line of wide extent; mud-flats, where, of course, the marine plants could not live, as their seeds do not take root in the mud; and where even their *débris* could not be preserved, on account of the softness and of the alternance of water over the surface. All the vegetable remains of the Dakota group, preserved either with their substance, or by impressions only, are pieces of hard wood, rootlets, and branches, with leaves of coarse, thick texture. Per contra, the sandstone with fucoids, or the Eocene, being slowly upheaved from deep water, was inhabited by a marine vegetation of long standing, which, though covered by successive sandy deposits, could but thrive, till near the surface of the sea, where we see it intermixed with fragments of exogenous land-plants washed on the shores, and indicating a new period or the beginning of a land formation.

2. That vegetable Permian types should not be represented in the flora of the Dakota group, though both formations are in immediate juxtaposition, is not a matter of concern. But it is not the same when we recognize in these vegetable remains of the Cretaceous a total absence of representatives of the preceding formation, the Jurassic, whose flora is a compound of *Ferns*, few *Equisetaceæ*, some *Conifers*, and especially of a prodigious abundance of *Cycadeæ*. Three-fourths of all the fossil *Zamiæ*, and half of the *Cycadeæ*, known from all the geological formations, belong to the Jurassic. In the lower Cretaceous of Greenland, Heer finds still a marked proportion of species of this family, there being nine *Cycadeæ* in a group of thirty-six species of land-plants, a proportion of

* Conclusion of the report on the flora of the Dakota group, now in progress of pubic ation.

35 per cent. of the land flora of that epoch, as far as it is known. In the Dakota group, the only trace of a vegetable possibly referable to the *Cycadeæ* is the *Pterophyllum (?) Haydenii*, which, as it is remarked in the description, is considered by Schimper as of doubtful affinity. Prof. Heer, too, finds in the upper Cretaceous of Greenland a flora of twenty-eight species, mostly of Dicotyledonous plants without any trace of *Cycadeæ*.*

3. This absence of a predominant antecedent vegetable type in the Dakota group is not more remarkable than that of the Palms, which for the first appear in an extraordinary proportion in the lower Tertiary strata, just above the deep marine formation overlaying or following that of the Dakota group. The section of the cretaceous strata, as copied from Hayden's report, page 2, indicates in ascending a succession of beds of clay of a thickness of about two thousand feet, overlaid by five hundred feet of cretaceous sandstone, over which we find the lignitic formation with its peculiar flora, especially its abundance of Palms. The series of strata between the Dakota group and the Eocene has been uninterrupted as far as can be judged from the compound and the fossil animal remains. This does not indicate a period of long duration, at least comparatively to other more complex geological groups, and nevertheless the Cretaceous flora of ours has not a single species which might be referable to, or is recognized as identical with any of the land-plants of the Eocene, especially no trace of its essential representatives, the Palms. The proportion of Sabal is marked in the lignitic at Golden especially, at Black Butte, &c., not only by the remains of leaves, which in places fill thick strata of sandy clay, but also by fossil wood of the same class of plants, or by their trunks transformed into coal and identified by the characters of their preserved internal structure.

4. The essential and more numerous vegetable remains in the Da-

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*Since the above was written I have received from Professor Heer a most interesting pamphlet *on the Sweden expeditions for the exploration of the high North*. In this paper the celebrated professor gives, first, an abridged narrative of the progress and casualities of these explorations, and then sums up in a masterly manner the results obtained for vegetable paleontology, as far, at least, as they were recognized from a preliminary examination of an immense amount of materials collected and sent to him.

From the Lower Cretaceous of the northern side of Noursoak Peninsula, and in a bed of black shale overlaying the gneiss, which form the essential bulk of the land, he finds a flora of sixty-eight species, of which seventeen belong to Conifers, nine to Cycadeæ, thirty-eight to Ferns, three to Equisetaceæ, and only one to Dicotyledonous; this is a peculiar kind of poplar. On the south side of the same peninsula, near Atanekerdluk, on another formation of grayish black shale, Professor Nordenskiöld, director of the expedition, discovered a quantity of well-preserved vegetable remains at a higher stage, or of the Upper Cretaceous. The specimens represent sixty-two species, viz, ten Conifers, among them a *Salisburia* found with leaves and fruits; two Cycadeæ; thirteen species of Ferns; and thirty-four dicotyledonous species distributed in sixteen families and eighteen genera. Among these he mentions leaves of *Ficus, Sassafras, Diospiros, Magnolia, Myrtus, Leguminosæ*, &c., and remarks that some of the species are known already from the Quader sandstein of Saxony, Bohemia, Moletin, (Moravia.) Only five of these species, three Ferns and two Conifers, are identical with those of the first locality, or of the Lower Cretaceous. Eight hundred feet above this formation they still found strata of clay and sandstone filled with a prodigious quantity of remains of fossil plants, which, according to Heer, represent a flora of the Lowest Miocene, and where he identifies one hundred and thirty-three species, fifty of which are also found in the Miocene of Europe. This flora is totally different from that of the Cretaceous of the same country, and no species are identical. This Tertiary formation is covered like the whole land by immense deposi to flava.

This description corresponds in many points with what we know of the Upper Cretaceous of Kansas and the Lower Tertiary formations of the Rocky Mountains, and we shall probably find, when the species of Greenland are published, a number of them identical with those of the Dakota group.

kota group are leaves of Dicotyledonous, representing the three divisions of this class, and, what is more remarkable, the genera to which belong most of the living arborescent plants of this country and of our present climate. If what may be called positive characters of the genera—the flowers and the fruits—are not ascertainable from fossil fragments, it is at least impossible to deny the intimate relation of most of the leaves of the Dakota group to the genera to which they have been referred in their descriptions.

Beginning by the Apetalous, we have first *Liquidambar* leaves so similar to those of our sweet-gum tree, *L. styraciflluum*, by form and nervation, that in comparing the fossil leaves with those of our living species, no difference whatever can be remarked but in the entire borders of the fossil ones. They are more or less serrate-crenulate in the living species, as also in *L. Europeum* of the Miocene of Europe. But some species of the same formation, and considered by authors as referable to this genus, have leaves with entire borders. Even Gaudin, in his memoirs on the fossil leaves of Tuscany, figures as *L. Europeum*, three leaves, one of which, with entire borders, Pl. V, Fig. 3, looks like a counterpart of our Fig. 2, of Pl. III, the lateral nerves being marked as branches of the second pair of nerves, just as it is in our Cretaceous leaves, and not emerging from the top of the petiole as in the leaves figured by Heer under the same name. Gaudin accounts for the entire borders of this leaf by the supposition that the denticulation cannot be remarked on account of the coarseness of the stone where the leaves are imbedded. We could give the same reason or admit such a supposition, but the forms of the leaves of this genus are so distinct that the difference in the more or less serrate borders cannot prevent their generic identification. The leaves of the Cretaceous species are, especially by their truncate base and their general outline, rather related to those of our *L. styraciflluum*, than to those of the Asiatic form, *L. orientale*. These are the two only living species of *Liquidambar*, with palmately-lobed leaves.

The history of this Genus, its origin, and the present distribution of its species, offer with that of *Platanus* a coincidence worth remarking. Both appear first in the Dakota group; both pass through the Tertiary formations of Europe in different modifications, and both, too, have each for essential representatives of the present flora an oriental and an occidental form. In Asia, *Liquidambar orientale* and *Platanus orientale;* in our country, *L. styraciflluum* and *P. occidentalis*, of which the Mexican forms are mere derivations. No species of *Liquidambar* has been as yet recognized in our North American Tertiary formations. Two species widely distributed are described with numerous varieties from the Tertiary of Europe.

The numerous leaves which are referred to the genus *Populites* are comparable to those of the different species of poplars now inhabiting the north part of this continent. The relation is not positive, however. They essentially differ by the peculiar disposition of the secondary veins to run straight to the borders, a kind of nervation (*craspedodrome*) remarked in the leaves of the beech, and in very few indeed of the leaves, with entire borders of our present arborescent vegetation. Leaving out this difference and considering the apparent affinities, we have *Populus Haydenii*, referable to the section of the *Marginate* to which belong our *P. monilifera*, and some of its numerous varieties, *P. canadensis*, *P. angulata*, &c., and related also by its nervation and its peculiar denticulation to *P. candicans* of ours, and *P. balsamoides* of the Miocene. *Populites cyclophylla* and *P. lancastriensis* have typical affinity by their nervation and the enlarged form of the leaves with *Populus latior*, while *Populites elegans*

is referable to some forms of *Populus attenuata*, both these of the Miocene and to the living *P. nigra*. *Populites ovata* may be compared to *Populus mutabilis*, also of the Miocene. On account of the thick texture of the leaves it is placed in the section marked *Coriaceous*, of which there is no American representative at our present time. The thickness of the leaves of this last fossil *Populites* is not much more marked than in the other species of the genus. Scales of buds and seeds of poplars have generally been found in the Miocene of Europe, in connection with leaves referable to the genus. None of these vegetable organs have been discovered as yet in the shale of the Dakota group. The relation is, as remarked above, indicated merely by the form of the leaves, and this character is scarcely reliable to prove specific or even perhaps generic affinity.

It is not the same case, however, with the leaves of *Salix* and of *Fagus*, the willow and the beech. Their generic relation is positively indicated by the form of the leaves and by their nervation. Our *Salix candida*, Wild., as widely distributed as a shrub as the beech is as a tree, is the living willow most intimately related to the Cretaceous form. Its type is also represented in the Upper Tertiary or the Pliocene of California, especially. The species of *Fagus* of the Cretaceous is, by its entire, undulate leaves, rather referable to the present *F. sylvatica* of Europe than to our *F. ferruginea*. Both these species, however, are so similar that they were formerly considered by botanists as mere continental varieties, and are still admitted as such by many. They have on both continents the same wide and general distribution, being essential constituents of the forests of our present time. The beech has representatives in far distant countries, but its types are local, and all the exotic ones differ from that of our fossil species. Japan has one species with leaves cordate at base and borders obtusely crenate, the secondary nerves tending to the sinuses. Chili has five, with leaves obtuse, truncate at base, and borders mostly doubly serrate. South Central America has one of very wide distribution; it has small coriaceous dentate leaves. New Zealand has four, all with doubly serrate leaves and the lower surface white tomentose; and Tasmania has for its share two species of a still more distant type, with obtuse, truncate, and dentate leaves. *Per contra*, most of the species described as yet from the Tertiary are referable to the European or the North American types. *F. pristina* is related to our *F. ferruginea*. *F. antipofi*, from the Miocene of Alaska, is related to the same by the slightly dentate borders, but differs indeed by the larger size of the more taper-pointed leaves. *F. macrophylla* of the same formation and country has the leaves entire, like the European spices, but still of a far larger size, the specimen figured by Heer representing a leaf 16 to 18 centimeters long, and 10 centimeters wide. *F. deucalionis*, *F. feroniæ*, *F. horrida* have borders of leaves more or less dentate, and therefore more like the North American type. It is only when out of the geographical limits of the north occidental flora or in the Grecian Archipelago that we find a fossil species of *Fagus* related to an exotic form with doubly dentate small leaves: *F. dentata*, from Eubea, a species which Unger compares to the Chilian *F. obliqua*.

After this we find described from our Cretaceous flora: *Betula beatriciana*, comparable by the form of its leaves and its nervation to our *B. nigra*, so widely distributed from the northern shores of Lake Superior to Florida; seeds of *Myrica*; at least these which we have figured under this name, are undistinguishable from Heer's seeds of *Myrica* described from the Cretaceous flora of Quedlinburg, but indeed more flattened than the seeds of any of our present species; then leaves of oaks *Quercus primordialis*, of the type of the so widely distributed and variable *Q.*

prinus, the chestnut oak; *Q. ellsworthianus* and *Q. anceps*, types of our *Q. phellos* and *Q. imbricaria*, species with entire borders of leaves.

It would be hazardous to pursue further a typical comparison of the Cretaceous species of oaks, on account of the few materials found as representatives of this genus in the shales of the Dakota group. The few specimens, however, represent distinct, well-preserved leaves, from which at least we know that the oaks were already present in the Cretaceous flora of our continent. They appear few, in a modest way, though already of two distinct types; but soon the forms become more numerous and the genus takes an important place in the arborescent vegetation of the world. In the Eocene flora of the Rocky Mountains six species have been discovered already, among which one representing the third essential type of our oaks, marked with deeply pinnately-lobed leaves, as in the numerous species of the section of the North American black oaks. The Elk Creek specimens, which seem to represent two horizons of the Tertiary, have eight species; the Washakie group, and Carbon have six, and in the Pliocene of California the representatives of this genus are still more numerous and their types still more intimately related to those of the living species. The flora of the California chalk bluffs has six species of oaks, under only thirty-four species.

The three last genera of the Apetaleæ represented in the flora of the Dakota group are *Platanus*, *Laurus*, and *Sassafras*. Though no fruit of *Platanus* has been found till now with the leaves, these are, by their form and nervation, positively typified as representatives of this genus. Heer had already recognized *P. Newberrii*, in his *Phyllites du Nebraska*. To this I have added *P. Heerii*, far different from the former, as seen in the description; and *P. primæva*, which, from its likeness to *P. aceroides*, I was formerly induced to consider as a mere variety. Though, from the form of other mostly entire leaves, the Cretaceous species is apparently distinct, the analogy or similarity, as indicated by the characters of the leaves, is not the less remarkable. It is the type of the species later represented by acutely lobed and dentate leaves, which we recognize in the Eocene of the Rocky Mountains as *P. Haydenii*, in the Miocene of the same country and of Europe as *P. aceroides*, in the Pliocene of California as *P. dissectus*, and especially now as *P. occidentalis*.—*P. aceroides* was already considered by European authors as the ancestor of our *P. occidentalis* before the Cretaceous species had been discovered. Now, we have to refer the origin of our noble tree to a more ancient epoch.

Like that of *Fagus* and *Liquidambar*, the Cretaceous type of Platanus has not widely varied and multiplied, and also it does not appear to have changed its habitat in a marked degree, at least not in latitude. One species only, *P. aceroides*, and its variety, *P. guillelmæ*, is abundantly distributed in the Miocene of Europe, from Greenland as far south as North Italy, over an area of about twenty-six degrees of latitude, while the range of *P. occidentalis* is from the great lakes to the Gulf of Mexico, passing still farther south into Mexico by its analogous *P. Mexicana*. From Europe it has passed eastward as *P. orientalis*, in the same way as it has gone west from our country as represented by *P. racemosa* of California.

In the *Laurineæ* we have leaves referable by their form and nervation to the genus *Laurus* or *Persea*, and a well-preserved fruit, *Laurus macrocarpa*, which, comparable also to the fruits of *Cinnamomum* and *Sassafras*, is, from its association in the same localities with leaves of *Laurus*, admitted as belonging to this genus. It seems a southern type in comparing it to the other species of the Dakota group, but it is rather, I think, a shore type. Our *Laurus (Persea) caroliniana* extends in following the

shores from Virginia to Louisiana, and farther west in Texas. It is a meager remnant of a number of species of the same genus which inhabited our North American continent and that of Europe during the Tertiary period. We find some of them already in our Eocene, especially in Mississippi. Eight species of *Laurus* and two of *Persea* have been described from the Miocene of Europe. The genus enters by three species into the Miocene flora of the Baltic, but it has as yet no representative farther north. None has been described from the Arctic regions.

Sassafras belongs to the same family. The leaves of *Sassafras* are found in such great proportion in the southern area of the Dakota group, especially in Kansas, that the genus seems to have represented there a large part of the land vegetation. Our *S. officinalis* is, by its leaves, scarcely distinguishable from some of the varieties of forms of the leaves of the Cretaceous species, which, like the present one, seems to have had a remarkable disposition to variability. I have explained with the description of the fossil leaves what reasons have induced me to separate as species some of the more peculiar forms. I must say, however, that considering merely the outlines of the leaves of our present sassafras, it would be as convenient, if they were found distributed per groups and in a fossil state, to separate, as species, as large a number of these forms, as it has been done for the sassafras leaves of the Dakota group.

No species of sassafras has yet been recognized in the more recent geological formations of this continent. Three species are described from the Tertiary of Europe, one of which, *S. Ferretianum*, is in the Miocene of Greenland, as also in the same formation of Italy. The wide range of distribution of *S. officinalis*, the only living species, also limited to this continent, is well known. It extends from Canada to Florida, and over the same latitude, from the borders of the Atlantic to the Western prairies, even as far west as the region of the Dakota group, along the banks of the Missouri River near Omaha. The distribution of this beautiful, odorant and sanative shrub, which in good situations becomes a tree of moderate size, is as remarkable as its exclusive affection for the land of its origin.*

The division of the Gamopetaleæ is not as positively and evidently represented in this Cretaceous flora as the former. Heer, however, has recognized in the *Phyllites du Nebraska* leaves referable to *Andromeda* and *Diospiros*, two genera still present in the flora of this country. The leaves are fragmentary. But the celebrated author considers the reference as certain. There is in the Tertiary of Europe and of this continent a number of species of the same genera. No less than twenty-four *Diospiros* species are described from the Miocene; among them, two from Alaska and Vancouver Island. Of nearly one hundred of species known of the flora of our time, *D. virginiana*, the persimon, is the only one which has been left in the temperate regions of the North American continent. None belongs to Europe. Of the two species more intimately allied to the North American one, *D. Lotus*, a native of China, is often cultivated in the south of Europe; the other, *D. Kaki*, is from Japan; both have eatable fruits.

Proceeding further and coming to the division of the Apetalœ, we find among the fossil leaves of the Dakota group an *Aralia* leaf similar in its essential characters to one described by Heer from the Cretaceous of Europe. There is a slight difference which may be considered a specific, but generic identity is undoubtful; an *Hedera* whose affinity is marked

*Like that of our *Cornus florida*, the acclimatization of this species has not succeeded in foreign countries.

by the outline of its coriaceous leaves and still more by their nervation; two species of *Magnolia*, represented by a large number of leaves and recognized already in the *Phyllites* by Heer, and three species of *Liriodendron*, the tulip tree, whose form of leaves like that of the *Sassafras* sufficiently proves the generic reference.

Considering these genera separately in regard to their relations and to their present and past distribution, we find *Aralia* still represented in our flora by six species, all of different characters of leaves. For indeed the relation of the fossil form is rather to an old section of the Aralia with compound palmate leaves, now referred to the *Hedera* like *H. Xalapensis* of the mountains of Mexico. This type is still represented by large leaves in the Pliocene flora of California. *Hedera helix*, the ivy to which our Cretaceous species *H. ovalis* is closely allied, is indigenous of Europe, where its origin is confirmed by paleontology, the species having been recognized in the Pliocene of Italy. It is, however, of so easy acclimation with us that it looks like an old wanderer returned home after a long absence. In the temperate zone of the United States, it invades walls and stone-dwellings as it covers the ruins of the European castles of old. The genus *Aralia* is not represented yet in the fossil Tertiary flora of Europe.

But evidently these two most admirable genera of trees, *Magnolia* and *Liriodendron*, belong to North America by origin, succession, and presence. Of the eight species of true *Magnolia*, *(Magnoliastrum,)* now known to botanists, seven belong to the western slope of the temperate zone of North America, and the other *M. Mexicana*, is either a variety of *M. glauca*, or *M. grandiflora*, or even is referable to a different genus. We have seen that already two species of *Magnolia* have been recognized by Heer in the Dakota group. I have added two species to the number, one of which, however, is of uncertain affinity. In our lower Tertiary, the Eocene, we have still seven species; five of them in the Mississippi Eocene, one at Carbon, and one at Black Butte. Of the Mississippi species, two have been found in the Raton Mountains, New Mexico, marking thus the genus with the same climatic distribution as it has now; or with wandering representatives far from the limits of its area of general distribution. Thus, one of the species *M. Inglefeldi*, found at Black Butte, is described by Heer from the flora of Greenland, just as we find now groups of *M. glauca* and *M. umbrella*, isolated in deep gorges of Pennsylvania, far out of their mean range of habitat. In the Pliocene of California the genus has two species. In the Tertiary formations of Europe it has none. As remarked above, however, one species is described from Greenland, and two from the Cretaceous formation of Moletin, these of a type different from that of the Dakota group species.

Liriodendron, the tulip tree, has in its characters, its distribution, and its life a great degree of affinity with *Magnolia*. The American species is the only one known now in the vegetable world, and its habitat is strictly limited to this country. It does not ascend higher than the fortieth degree of latitude, except, perhaps, casually, like *Magnolia* under the protection of favorable local circumstances. The genus does not appear to have any disposition to modifications of its type and to migrations. We have not as yet any fossil remains of it in our Tertiary formations. In that of Europe it is represented from Greenland to Italy by one species only. The leaves of different forms described from the Dakota group as four species, may perhaps be referable to a single one, as the characters, especially the size of the leaves, may be local and result from climatic circumstances. It has thus passed

a solitary life. Even now by the singular and exclusive form of its pale-green glossy leaves, by its large cup-shaped yellow flowers, from which it has received its name, by its smooth exactly cylindrical stem, gracefully bearing an oblong pyramidal head of branches, grouped with perfect symmetry, it stands widely apart from the other denizens of our forests, as a beautiful stranger, or rather as a memorial monument of another vegetable world. Either considered in its whole or in its separate characters, the tulip tree is an universal and constant subject of admiration and wonder. It could be named, not the king, it is not strong enough for that, but the queen of our forests, if the *Magnolia* was not there with him to dispute the prize of perfection by the still grander majesty of its stature, the larger size of its foliage, the elegance and the perfume of its flowers. Our sense of admiration for these noble trees is heightened still by the dignity of their ancient origin.

I have referred to the family of the *Menispermaceæ* under the generic name of *Menispermites*, a large number of leaves related by their form and nervation to those of the American species of *Menispermum*. *M. Canadense* and *M. Smilacinum*. The relation appears to me as positive as it can be established from a single kind of vegetable organs, the leaves. This relation may be searched for in plants of a far distant country and of a different climate, and there perhaps found as evident with another class of vegetables. But I can not admit that we have to look to foreign types for analogy of a vegetation whose essential characters are recognized in the species of this country. *Menispermum canadense* is now the consort of our *Platanus*, *Magnolia*, *Tulip-tree*, &c. It grows under the same climatic circumstances, and has the same habitat. As the leaves of the Dakota group compared to this species are like it, peltate, round or cordate, obtusely angular, of the same nervation and consistence, there is reason, indeed, to refer it to this family rather than to any other without any representative among us.

No species of *Menispermum* or *Menispermites* has been recognized from the geological formations except the species of the Dakota group. One-leaf, however, is described by Unger as *Acer obtusilobum*, which appears to me a true *Menispermites*. It has the secondary nervation of *Menispermum*, (*Cocculus Carolinus*,) and the basilar veins comes out from the borders of a round notched base, as in a peltate leaf. Unger doubtfully considers this leaf as a species of *Acer*. Till now we have not seen any appearance of organs of this last genus, either leaves or seeds, in the Dakota group, as we have none also in the Eocene. The maple seems to be of more recent origin, as it is remarked hereafter. However, one Cretaceous leaf, or the fragments of a double leaf, are referred with doubt to the genus *Negundo*. As the leaf is not complete, its outline indefinite, it is useless to argue upon its possible affinity, and for this, as for some others, we have to wait for the discovery of more perfect materials.

The relation of other leaves of the Dakota group to the genera *Paliurus*, *Rhamnus*, *Juglans* or *Rhus*, and even *Prunus* appears sustained by sufficient evidence. The character of leaves of *Paliurus* and *Rhamnus* are not likely to be mistaken. Both these genera have identifiable remains in the Tertiary of the Rocky Mountains; one *Paliurus* is found in the Eocene of Golden and Black Butte, and another in the Miocene of Carbon and Washakie. This last is an arctic species, also recognized by Heer in the Miocene of Greenland and Spitzberg. *Rhamnus* is especially well represented in our lower Tertiary. Eight species are described from Golden, Black Butte, and the Raton Mountains, four of which are in the Miocene of Europe, where the genus has fourteen species. It is therefore an old type well established at the beginning of our Tertiary period;

and it is not surprising to find it already in the upper Cretaceous flora. Its present distribution is mixed. The genus preserves its predominance in Europe by the number of its species; it has there more than a dozen, while North America has only four or five.

It is remarkable that the next closely allied genus, *Ceanothus*, has not yet been recognized in the Dakota group, though now an exceptional American type. It has one species in the Eocene of Golden, another, very fine, in the same formation of the Mississippi, and many more in the upper Tertiary of the Rocky Mountains, and especially in the Pliocene of California. The ten living species of true *Ceanothus* described in the D. C. Prodromus, belong to the United States, especially to the southern zone, and a number of them are added to the list by the as yet unpublished flora of California. The absence of the type in the Cretaceous of the West is in accordance with the fact remarked upon in describing the general character of the leaves of the Dakota group, viz, the absence in this group of any kind of serrate leaves.

It is uncertain whether the compound leaves of which a number of separate leaflets have been figured in this memoir as *Juglans Debeyana*, represent a species of *Juglans*, or of *Rhus*. I am inclined now to refer them to this last genus, especially on account of the nervation more analogous to that of the present *Rhus metopium*, of Florida,* whose leaves also resemble somewhat the fossil ones; but there is as yet no sufficient evidence on this account. In considering the distribution of the species of both *Rhus* and *Juglans*, in the subsequent formations, we do not find any difference pointing out to a predominance of one of these types at any time. From the Dakota group, two other kinds of leaves are referable to *Rhus*. In the upper Tertiary of the Rocky Mountains we have four, and it is well proved now that the relation of our vegetable Cretaceous types is not with Eocene species, but rather with those of the upper Tertiary and of the present flora. On another side, *Juglans acuminata* and *J. rugosa* which by their somewhat coriaceous entire leaves are distantly related to the Cretaceous species, have been recognized at most of the localities where Tertiary fossil plants have been found; they are at Carbon and also in the Eocene at Golden, the Raton, Black Butte, &c., and thus seem to indicate by their general distribution the origin of *Juglans* in the Cretaceous group as evidently as that of *Rhus*. From the Miocene of Europe about twelve species of this last genus have been described, two from the Arctic regions; and from the same formation as many species of *Juglans*, with six species of *Carya*. At our time *J. regia*, so generally known and cultivated for its large fruit, is of Asiatic origin, while of the other four species known, three belong to the middle zone of the United States, which has also for its share all the living species of *Carya*. Of the living species of *Rhus*, Austral Europe has two; one of which, *R. cotinus*, has been compared by the form of its leaves to *R. emarginata* of the Dakota group. We have in North America, besides *R. metopium*, which is rather a tropical form, six species of the section of the pinnately-divided leaves, with the trifoliate *R. toxicodendron* and *R. aromatica*, both extremely variable, all types already represented in the Pliocene of California.

Except an *Amelanchier*, described by Dr. Newberry in his Notes on Extinct Floras, &c., from the Tertiary beds of the Yellowstone, we do not know as yet any fossil species of Rosaceæ from the western Tertiary measures. This is not a reason why *Prunus* should be excluded from

* The species is indigenous in Cuba. I have specimens from South Florida, but it may be there cultivated.

the list of the genera of the Dakota group. By their present distribution, our *P. serotina* and *P. Virginiana* indicate an extreme power of life, or of resistance to climatic changes, both being the only arborescent species of this continent, with a range of 30° to 35° in latitude, and both, too, being found everywhere, on every kind of ground; the one as a shrub along the banks of streams, the other as a fine tree in our woods. And, also, we have in our *P. Caroliniana*, a shore tree of the South, a species whose coriaceous entire leaves recall the essential characters of those of the Dakota group. Three species of this genus are described from the Tertiary of Europe, none as yet from ours; but it is probable that fossil remains referable to it will be found hereafter, as it has in our present flora a larger number of species than in that of Europe, or of any other part of the world. Of the species described by De Candolle, fourteen are North American, five European; four species belong to Japan, &c.

Resuming in a few sentences the above remarks, we find: That the Dicotyledonous flora of the Dakota group represent species referable to the genera *Liquidambar*, *Populus*, *Salix*, *Betula*, *Myrica*, *Quercus*, (in two of its principal types,) *Ficus*, *Platanus*, *Laurus*, *Sassafras*, *Cinnamomum*, *Diospiros*, *Aralia*, *Magnolia*, *Liriodendron*, *Menispermum*, *Negundo or Acer*, (?) *Paliurus*, *Rhus or Juglans*, (?) and *Prunus;* or, merely considering the affinities to our present flora, of twenty genera, seventeen of which are those to which belong the species of our trees and shrubs which have the more general and the widest range of distribution. Indeed, all our essential arborescent types are there, except those which are marked by serrate or doubly-serrate leaves: *Tilia*, *Æsculus*, all the serrate *Rosaceæ; Hamamelis*, *Fraxinus;* the *Urticineæ; Planera*, *Ulmus*, *Celtis*, *Morus;* and of the *Amentaceæ*, the serrate *Betula*, *Alnus*, *Ostrya*, *Carpinus*, *Corylus*, *Carya*, *&c.*

This enumeration exposes the general facies of the leaves or of the flora of the Dakota group, viz, integrity of the borders and coriaceous consistence of the leaves. The borders, if not perfectly entire, are merely undulate or obtusely lobed. There is only one exception to this in that peculiar short denticulation with outside turned teeth, which is marked, exactly of the same kind, in *Populites Haydenii*, *P. flabellata*, *Platanus Newberryi*, *Quercus Mudgii*, and the fragments described as *Phyllites betulæfolius*. This mode of division of the borders of leaves is very rare in species of our present times, except, perhaps, in some leaves of poplars. A single of the leaves of the Dakota group *Quercus primordialis* has the borders distantly serrate or marked by teeth turned upward. There is also in the flora of the Eocene of the Rocky Mountains a marked preponderance of leaves with entire borders. The serrate leaves appear in the Miocene, with *Acer*, *Alnus*, *Corylus*, and become predominent in the Pliocene of California, where *Ulmus*, *Planera*, *Celtis*, *Carya* abound, though these genera are not more in the flora of the Pacific slope.

But of the detailed correlation of the flora of the Dakota group with that of the subsequent geological epochs of this continent, I will say nothing more now until the materials on hand are definitely described and figured for comparison.

There is little to say on the analogy of this Cretaceous flora of ours with that of any of the Cretaceous groups of other countries. Of the Ferns, we have a *Gleichevia Kurriana (?)* apparently identical with the form described under this name from Moletin. Of the Conifers, there is a specimen doubtfully referable to *Geinitzia* and of the Dicotyledonous, an *Aralia* leaf, also closely allied to species of the same locality. With the flora of the Quader Sanstein of the Hartz, that of the Dakota group

is related by *Pterophyllum* (?) *Ernestinæ* and *Quercus Mudgii*, and to that of the same formation of Niedershœna, as described by Ettinghausen by a *Cunninghamites*, a *Glyptostrobus*, (*Frenelites*,) and *Ficus Halliana*. And, too, we have to admit an uncertain relation with Australian types by the species described by Heer as *Proteoides*, and by one leaf of Conifer, *Phyllocladus*, a type extinct on this continent.

This is sufficient to prove, relatively to our present knowledge, at least, the truth of the assertion, that the flora of the Dakota group, without affinity with any preceding vegetable types, without relation to the flora of the lower Tertiary of our country, and with scarcely any forms referable to species known from coeval formations of Europe, present in its whole a remarkable and as yet unexplainable case of isolation.

DESCRIPTIONS OF SOME NEW ORTHOPTERA, AND NOTES ON SOME SPECIES BUT LITTLE KNOWN. BY CYRUS THOMAS.

Minorissa alata, sp. nov.

Corresponds very closely with Walker's description of *M. pustulata*, except that the wings are fully developed and nearly as long as the elytra.

The sides of the pronotum are not tuberculate except the slight tubercles along the lower margin. Color uniform pale-green.

The following additions may be made to Walker's generic characters: Posterior femora shorter than the abdomen, triangular; head slightly ascending.

The anterior and middle transverse lines of the pronotum are nearly obsolete in the single specimen I have examined.

Dimensions.— ♀, Length, 1.4 inches; elytra, 1 inch; posterior femora, 0.52 inch; posterior tibia, 0.50 inch.

Habitat unknown; the specimen, which is somewhat mutilated, found in the collection at the Agricultural Department, without any mark indicating the place where it was obtained. It is probably from some part of South America.

Opomala mexicana, Sauss., Rev. et Mag. Zool., XIII (1861), 156.

Slender, cylindrical elongate.

Female.—Occiput somewhat elongate, slightly ascending, with a shallow punctured sulcus each side, the two approaching in front. Vertex narrow between the eyes, expanding in front of them, rounded in front, this portion being about as broad at the base as it is long; a shallow channel along the middle; margin not raised. Eyes very oblique, oblong, ovate. Face very oblique; the middle pair of carinæ distinct above, somewhat fading below; lateral pair indistinct. Antennæ rather short, enlarged at the base, but somewhat thick and but slightly flattened; edges rounded. Pronotum a little longer than the head, cylindrical, without carinæ; sides parallel; transverse incisions minute and indistinct; the posterior one about two-thirds the length from the front; posterior margin obtusely rounded; its entire surface, as also the top of the head, minutely granulose. Elytra elongate, passing the abdomen about one-third their length; very narrow and lanceolate; wings nearly the same length. Posterior femora reach the tip of the abdomen

Color (dried).—Pale olive-brown, with a yellow stripe commencing at the lower angle of the eye and running along the lower margin of the side of the pronotum to the insertion of the posterior leg; this yellow margin or fascia each side is very distinct and marked; otherwise the color is somewhat uniform, except the posterior tibiæ, which are blue.

Male.—Differs from the female in being smaller, slenderer, and as follows: The vertex is more pointed; the transverse incisions of the pronotum almost wholly obliterated; the elytra almost linear; the subanal plate elongate, pointed, curved upward; the pinnæ of the posterior femora dim, and scarcely V-form; the posterior femora scarcely as long

as the abdomen; the lateral marginal stripe white; the abdomen a shining dark-brown.

Dimensions.— ♀, Length, 1.25 to 1.5 inches. Specimens were received from Mus. Comp. Zool., Cambridge, and from the Agricultural Department, Washington.

Pyrgomorpha brevicornis, Walk.

Male.—Sides of the head, pronotum, and of the closed elytra perpendicular, flat, compressed. Top of the head slightly ascending to the tip of the vertex; the vertex between the eyes rather broad, slightly convex; the portion in front of the eyes short, scarcely exceeding its width, rounded at the apex; a very slight median carina in the front portion; margins scarcely raised; no foveolæ. Face quite oblique, straight, narrow above and expanding below, quadricarinate; the carinæ minute but distinct, moderately divergent, reaching to the clypeus. Antennæ longer than the head and thorax, enlarged at the base, triquetrous. Eyes placed high and well forward, oblique, ovate, acuminate at the apex. Pronotum a little longer than the head; sides parallel; tricarinate, the three carinæ distinct but not elevated, the lateral consisting of the angle formed by the perpendicular sides with the nearly flat disk; one minute transverse incision a little behind the middle. Elytra and wings extend about one-third their length beyond the extremity of the abdomen; the former obliquely truncate at the tip. Posterior femora slender, nearly as long as the elytra. Subanal plate conical.

Color.—Brown and green. Face, and the entire dorsal surface, uniform bright green; the entire sides fuscous brown; anterior and middle legs and posterior femora green; posterior tibiæ dusky; spines white, tipped with black; antennæ brown.

Dimensions.—Length, 0.91 inch; length to tip of elytra, 1.25 inches; elytra, 0.86 inch; posterior femora, 0.64 inch.

Remark.—This specimen, which is from Texas, received from Mus. Comp. Zool., is evidently Pal. Beauvois' *Truxalis notochlorus.* I am now very strongly inclined to the opinion that my *P. punctipennis* is but a variety of this species. I am also well satisfied that this is the species I saw at Murphysboro, Illinois, which produced such a loud crackling noise in leaping. (Rept. Ills. St. Agl. Soc., vol. v.)

Gomphocerus simplex, Scudd.

I have a specimen of what I am inclined to think is Mr. Scudder's *G. simplex*, which was collected by Mr. Uhler in Maryland, and communicated to me by Prof. T. Glover; but as it varies somewhat from Mr. Scudder's description, I give here a full description:

Male.—Back part of the head ascending, tricarinate; these three carinæ minute, but distinct and close together; the lateral ones bend suddenly outward at the upper angle of the eyes and connect with the raised margins of the vertex; the median carina continues to the tip of the vertex; vertex slightly ascending and rounded in front; no lateral foveolæ. Face quite oblique and slightly arcuate; frontal costa rather broad, of equal width throughout, and sulcate; lateral carinæ distinct, divergent. Antenna about as long as the head and thorax; the club very distinct, commencing at the thirteenth or fourteenth joint. Pronotum with the sides nearly parallel; the lateral carinæ curving inward slightly about the middle; the three slight carinæ of the head are continued with equal distinctness along the middle of the pronotum, parallel, and preserving the same distance from each other as on the head; the lateral

carinæ though minute are distinct; the disk shows one minute transverse incision a little beyond the middle; posterior margin obtusely rounded.

Elytra extend beyond the abdomen; lower (costal) border somewhat expanded about the middle, and diaphanous; wings as long as the elytra. Posterior femora extend to the tip of the elytra. Subanal plate subconical.

Color, (dried).—Face pale, testaceous; mouth-parts whitish. Upper surface of the head and pronotum testaceous brown along the central portion, with a black stripe each side extending from the vertex to the posterior extremity of the pronotum, filling the space between the outer median and lateral carinæ, though at the curve of the lateral carinæ it shows a slight dash exteriorly; lateral carinæ bright yellow; sides testaceous, darkest along the middle portion, paler below. Elytra testaceous-brown, with two or three irregular fuscous and pale spots along the disk. Wings (not opened) fuscous at the apex. Posterior femora dull-yellow; upper carinæ slightly touched with fuscous; tibiæ dull-white (probably bluish when living); spines tipped with black. Basal portion of the antennæ testaceous; club fuscous.

Dimensions.—♂, Length to tip of elytra, 0.64 inch; elytra, 0.48 inch; posterior femora, 0.40 inch; posterior tibiæ, 0.37 inch.

Gomphocerus carpenterii, sp. nov.

Male.—Anterior tibiæ enlarged; disk of the pronotum gibbous; very similar to *Stenobothrus sibiricus*, Fisch.

Vertex triangular in front, the carinate margins forming a right angle at the apex, scarcely expanding in front of the eyes, horizontal; lateral foveolæ distinct, linear. Face somewhat oblique; frontal costa rather broad, flat, not sulcate, and only very slightly indented at the ocellus, above which it is punctured, and below which it extends but a short distance; lateral carinæ subdistinct, diverging. Antennæ little longer than the head and thorax; club flat, ovate, commencing about the sixteenth or seventeenth joint. Pronotum of nearly uniform width throughout; the sides and disk gibbous, the swell of the sides being chiefly on the anterior portion of the middle lobes, the swell of the disk on the middle lobes, but is distinctly limited by the posterior transverse incision; the posterior incision cuts all the carinæ, but does not notch them; it is situated considerably behind the middle; the middle transverse incision is somewhat distinct, but on the sides only; two punctures on the disk appear to represent the anterior transverse incision (in my unique specimen); the three carinæ distinct minute, the lateral strongly curved inward near the middle, posterior extremity obtuse-angled. Elytra a little longer than the abdomen; narrow at the base and expanding a little more than usual in the middle; nervules of the costal margin distant, parallel; nervules of the middle field somewhat distant, mostly transverse and scalariform. Wings about same length as the elytra. Posterior femora a little longer than the abdomen; anterior tibiæ considerably enlarged; middle tibiæ of the usual form. Posterior part of the pronotum minutely tuberculate.

Color (after immersion in alcohol).—Brown, shaded with black. Face pale cinereous; cheeks mottled with fuscous; top of the head black, with a palish stripe along the middle of the occiput. Middle and anterior lobes of the pronotum dark-brown, with some paler markings on the sides; the posterior lobe, with the upper portion of the sides, including the lateral carinæ and a middle stripe, dull rufous; the interspaces of

the disk and middle portion of the sides black. There is a paler irregular stripe on the sides. Sides of the meso and metathorax black. Elytra brownish, semi-transparent; an indistinct rufous stripe along the interno-median nerve, most distinct near the base. All the legs purplish brown; the under side of the posterior femora yellowish. Venter and pectus yellowish.

Dimensions.—Length, 0.70 inch; elytra, 0.50 inch; posterior femora, 0.35 inch; posterior tibiæ, 0.35 inch.

Named in honor of Lieut. W. L. Carpenter, who discovered it near the Mountain of the Holy Cross, in Colorado, at an elevation of 8,000 to 10,000 feet above the sea.

Remarks.—This species is exceedingly interesting, as showing the strong tendency of similar conditions to produce similar forms. The *Stenobothrus (Gomphocerus) sibiricus* is a peculiar form occuring only in the higher mountains of Europe and extreme northern portions of Europe and Asia. Here we find the same abnormal characters (enlarged front tibiæ and gibbous pronotum) occurring under exactly similar conditions; *i. e.*, in the higher mountain-portions of Colorado in the vicinity of perpetual snow.

Thrincus californicus, sp. nov.

♀. Small size, bright reddish-brown, with fuscous dots. Head very short, drawn back in the pronotum nearly to the eyes; occiput very short, a slight tubercle each side near the upper canthus of the eye. Vertex rather broad, but not transverse, very slightly deflexed, not expanded in front of the eyes; margins elevated, sharp, parallel between the eyes, meeting in a subacute angle in front; lateral foveolæ minute, triangular. Frontal costa narrow at the apex, expanding at the ocellus, but solid immediately above the ocellus margins carinate above the ocellus; lateral carinæ distinct, bending forward somewhat angularly opposite the antennæ; lower portion diverging toward the corners of the face.

Pronotum short, expanding rapidly posteriorly, rugose, tuberculate; median and lateral carinæ indistinct except on the front part of the posterior lobe, and there they are obtuse; the transverse incisions are not distinguishable except the posterior one, and this only on the sides, where it forms an irregular tortuous indentation; a somewhat prominent and slightly elongate tubercle on the front margin immediately behind each eye; two somewhat prominent tubercles on the disk close together at the front margin of the posterior lobe; the disk of the posterior lobe, although flattened, is somewhat elevated, and covered with elongate tubercles; posterior margin right-angled, rounded at the tip, marginate.

Elytra extend a short distance beyond the tip of the abdomen; rounded and curved upward at the extremity. Posterior femora short, not reaching the extremity of the abdomen, considerably inflated, and thick toward the base, but the upper and lower carinæ not prominent; disk convex; pinnæ prominent and minutely hairy. Antennæ rather short, not reaching the extremity of the pronotum, not subacuminate (as shown by Fischer) but slightly flattened toward the apex, filiform.

Color.—A bright reddish-brown, with but few fuscous dots and markings as follows: Four or five spots along the disk of the elytra; a few smaller ones in the lower field; and two double short bands across the upper field. (Wings not spread, but appear to be yellowish at the base and fuscous at the apex). Posterior tibiæ greenish or pale-blue; tarsi

dull-white. The pectus, which is very broad, even slightly transverse, is an ashy-green.

Male.—Is much smaller and differs otherwise as follows: More slender in its proportions; back of the head more elevated, and eyes more prominent; pronotum less rugose, and not expanding so rapidly posteriorly; median and lateral carinæ of the pronotum more distinct; color, especially of the pronotum and posterior femora, a darker brown. Anterior and middle tibiæ twice distinctly banded with black.

Dimensions.— ♀, Length to tip of elytra, 1 inch; from tip of the vertex to tip of pronotum, 0.27 inch; width of thorax at middle legs, 0.28 inch; elytra, 0.80 inch; posterior femora, 0.50 inch; posterior tibiæ, 0.40 inch. ♂, Length to tip of elytra, 0.70 inch; elytra, 0.56 inch; posterior femora, 0.30 inch.

Collected in Southern California by Mr. Crotch, and obtained by me from the Museum of Comp. Zool., Cambridge, Mass.

This very interesting species is the first, so far as I am aware, that has been found in the United States belonging to this genus.

Ommatolampis brevipennis, sp. nov.

Elytra and wings shorter than the abdomen, green; dorsum rufous or reddish-brown, and a black stripe on the sides of the pronotum.

Female.—Tip of the vertex prominent in front of the eyes, diamond-shaped and slightly indented in the middle; eyes closely approximate above, prominent; face suboblique; frontal costa deeply sulcate throughout, reaching to the clypeus, parallel; lateral carinæ subdistinct and nearly parallel. Pronotum subcylindrical, scarcely expanding posteriorly; sides nearly parallel; median carinæ subdistinct; lateral carinæ obliterated; posterior transverse incision distinct, situated behind the middle, about two-thirds the distance from the front; apex obtuse-angled, rounded at the point. Elytra and wings extend over about two-thirds of the abdomen.

Color.—General color green, with the following markings: Fastigium, a central spot in the face, a stripe along the middle of the pronotum; the dorsal portion of the elytra (closed) and a dorsal stripe on the abdomen rufous; a narrow stripe along the external margin of the posterior femora, and the entire anterior and middle femora bright coral-red. A black stripe on each side of the pronotum extending back only to the posterior transverse sulcus; it is sometimes interrupted by a yellowish and reddish spot near the posterior end, and is usually bordered below by a narrow yellowish or orange stripe. Antennæ bright rufous except the basal joint, which is green. Posterior tibiæ green; spines same color, except the tips, which are black.

Male.—Differs from the female only as follows: Is smaller; the anterior and middle transverse incisions of the pronotum more distinct; elytra and wings nearly as long as the abdomen; subanal plate strongly curved upward and somewhat pointed at the apex. Prosternal spine in both sexes robust, somewhat conical.

Dimensions.— ♀, Length, 0.90 inch; elytra, 0.48 inch; posterior femora, 0.52 inch; posterior tibiæ, 0.48 inch. ♂, Length, 0.70 inch; elytra, 0.37 inch; posterior femora, 0.44 inch.

Taken in New Jersey in August, and communicated to me from Professor Uhler, through Professor Glover. A specimen in Lieutenant Wheeler's collection from Nevada resembles this somewhat closely; but as it is alcoholic, I cannot compare colors.

Caleoptenus flavolineatus, sp. nov.

Male.—Similar in appearance to *C. spretus;* ground-color yellow, with brownish markings, as in *C. spretus;* tibiæ blue.

Vertex rather narrow between the eyes, distinctly channeled, strongly deflexed; frontal costa broad and flat between the antennæ, fading and obliterated below; lateral carinæ distinct and diverging to the corners of the face. Antennæ of medium length. Eyes rather prominent, not docked in front. Pronotum comparatively short; median carinæ distinct on the posterior lobe, obliterated or indistinct on the other lobes; lateral carinæ subdistinct; the three transverse incisions very distinct, the third a little behind the middle, the first and second close together; posterior extremity obtusely rounded. Elytra and wings extend beyond the abdomen. Tip of the abdomen turned up but scarcely enlarged; cerci rather short, somewhat broad at base, but near the extremity tapering suddenly to a tooth-like apex; subanal plate rather narrow and very slightly (if at all) notched at the tip. Posterior femora extend beyond the abdomen; rather more than usually enlarged near the base. Prosternal spine robust and somewhat transverse.

Color.—Antennæ yellow; face orange-red; mouth-parts and a stripe in front of and below the eyes, yellow; pronotum pale orange-brown, with a front marginal yellow line; a yellow stripe from the base of the wings to the base of the posterior legs. Abdomen same color as the pronotum, with yellowish rings on the margins of the segments. Posterior femora pale-yellow along the margins of the disk, on the lower carinæ; under and internal surface reddish except the lower yellow carinæ; external face with three irregular oblique dark bands; pinnæ yellowish; knees black above. Posterior tibiæ blue; tarsi pale. Pectus and venter yellowish.

Dimensions.—♂, Length, 1 inch; elytra, 0.78 inch; posterior femora, 0.58 inch; posterior, tibiæ, 0.50 inch.

Collected in Southern California by Mr. Crotch, and received from Museum of Comparative Zoology, Cambridge, Mass.

This belongs to that section of the genus of which *C. fermur-rubrum* may be considered the type, and is somewhat closely allied to *C. spretus.*

Caloptenus floridianus, sp. nov.

Female.—Rather large size; dark grayish-brown, with a dark stripe each side.

Vertex slightly and somewhat angularly expanded in front of the eyes; the channel broad and distinct. Frontal costa somewhat broad, solid above the ocellus, somewhat sulcate below it, expanding at the ocellus. Pronotum about as broad as the head and uniform in width throughout; median carina minute yet distinct; posterior sulcus distinct, situated much behind the middle. First and second transverse incisions indistinct and much nearer together than second and third; disk of anterior lobes nearly smooth; disk of the posterior lobe thickly punctured; apex rounded. Elytra nearly as long as the abdomen, narrow and slightly lanceolate in form, with comparatively few transverse nervules. Wings about same length as elytra, rather narrow. Posterior femora extend to the tip of the abdomen. The corniculi of the ovipositor very prominent and sharp-pointed; the lower pair without any apparent lateral tooth or prominence.

Color.—An olive-brown slightly mixed with gray. A broad stripe of shining black or very dark-brown extends from the eyes along the sides of the head and pronotum to the posterior extremity of the latter; below

this stripe the pronotum is grayish or dull-white, somewhat mottled. Elytra almost uniformly olive-brown, without any distinct spots, though some dim dots of black are sometimes visible along the disk. Wings transparent, tinged with greenish-yellow. Abdomen a shining brown; valves of the ovipositor dull-white. Posterior femora with the under edge and inner face dull-yellowish, with an indistinct greenish-brown band near the knee; upper carinæ bluish or greenish; posterior tibiæ dark-blue; tarsi blue.

Dimensions.— ♀, length, 1.50 inches; elytra, 0.95 inch; posterior femora, 0.87 inch; posterior tibiæ, 0.77 inch.

Add.—Lateral carinæ of the face distinct, slightly divergent; frontal costa reaches the clypeus. Antennæ a little longer than the head and thorax; joints subdistinct. Pronotum rather longer than usual.

Florida. Received from the Agricultural Department. Specimen quite fresh in color.

Caloptenus keelerii, sp. nov.

Vertex quite narrow between the eyes, slightly and somewhat hexagonally expanding in front. Frontal costal moderately broad and of nearly uniform width throughout, slightly indented at the ocellus, otherwise in no way sulcate, fading or becoming obsolete before reaching the clypeus; lateral carinæ diverging toward the corners of the face. The pronotum regularly but very slightly expanding posteriorly, the front being just the same width as the head; the median carina minute but distinct throughout; the three transverse incisions moderately distinct, the posterior one a little behind the middle; the posterior extremity forms nearly a right angle, rounded at the apex. Elytra passing the abdomen, somewhat narrow and elongate-lanceolate, the lower (costal) margin not dilated at any point. Wings nearly the same length as the elytra. Posterior femora passing the abdomen. Antennæ a little longer than the head and thorax. The prosternal spine robust, subcylindrical, slightly bent backward, obliquely truncate at the apex, slightly transverse.

Color.—Brown, varied with purplish red. Face, disk of the pronotum, and upper edges of all the femora purplish-red. The black stripe behind the eye broad and indistinct, the lower edge not well defined, reaching only to the posterior sulcus of the pronotum. An oblique, pale, narrow stripe extends from the base of the elytra to the insertion of the posterior legs. Elytra brownish, with minute fuscous dots and somewhat cellular spots along the disk; these spots and dots are somewhat indistinct and run together. Wings transparent, tinged with yellow. Posterior femora with two oblique black bands on the exterior face, and two transverse bands; a basal and apical spot of black on the inner face; the lower margin of the internal face olive or olive-red. Posterior tibia brick-red; base yellowish, with a black ring just below it.

Dimensions.— ♀, Length, 1.12 inches; elytra, 0.88 inch; posterior femora, 0.70 inch; posterior tibiæ, 0.63 inch.

Collected in Florida by Mr. Keeler, and by him forwarded to the Agricultural Department, where they are now deposited. Although the description would seem to indicate that this species is very closely allied to the common *C. femur-rubrum*, yet this is not the case, as it is quite distinct.

Xiphocera pygmea. Sauss., Rev. et Mag. Zool., XIII (1861), 156.

Female.—Occiput subtricarinate; these carinæ minute. Vertex horizontal, advanced in front equal to the space behind the eyes; sides for

a little distance parallel, then rounding to the somewhat pointed apex; margins raised, subacute; on the inner surface two short minute carinæ. Face somewhat oblique, curved inward opposite the lower margin of the eyes; frontal costa prominent and projecting above the ocellus, deeply sulcate throughout, forming two carinæ, subparallel, except at the ocellus, where they suddenly approximate each other; lateral carinæ distinct, subparallel.

Antennæ rather short, scarcely reaching the tip of the pronotum, ensiform, and subtriquetrous. The eyes are somewhat inflated, but less so than in the male. Pronotum with the sides parallel except near the posterior extremity, where they are slightly divergent, granulose, and somewhat rugose; median carina slight; lateral carinæ indistinct, almost obliterated; posterior transverse sulcus subdistinct, situate behind the middle; posterior extremity obtusely rounded. Elytra a little longer than the abdomen; wings about the same length. The posterior femora do not reach the extremity of the abdomen; legs pilose; there is very little difference in the length of the outer and inner rows of the spines of the posterior tibiæ.

Color.—General color brown, with dim fuscous dots. Inside of the posterior femora bright coral-red; posterior tibiæ red; spines tipped with black.

Male.—Similar to the female except as follows: It is smaller. Eyes large, much inflated, and approximate above; antennæ slender and but slightly enlarged at the base; occiput and disk of the pronotum occupied by a broad, double, dull-yellow stripe; a broad stripe of the same color along the lower part of the sides of the pronotum; posterior femora indistinctly trifasciate with fuscous; face a little more oblique.

Dimensions.— ♀, Length, 0.94 inch; elytra, 0.61 inch; posterior femora, 0.45 inch; posterior tibiæ, 0.39 inch. ♂, Length, 0.61 inch; elytra, 0.56 inch.

Remark.—This species belongs to the second division of this genus as given by Saussure, and agrees with the second division of *Xiphicera* as given by Serville, except that the cerci are short and not curved.

Specimens were received of Mr. Scudder; they were collected by Sumichrast in Mexico.

I have given the description in full, as that of Saussure is so brief as to render it difficult to determine specimens not in color.

Machærocera sumichrasti, sp. nov.

Vertex slightly deflexed, broadly channeled; the channel apparently connecting with the narrow sulcus of the frontal costa; portion in front of the eyes about equal in length to that behind them, ovate-lanceolate in form; margins elevated, acute. Face moderately oblique, indented opposite the lower margin of the eyes, resembling *Xiphocera* in this respect; quadricarinate, the median pair close together above, regularly diverging below, reaching the clypeus; lateral carinæ distinct, diverging to the corners of the face. Eyes prominent, slightly inflated, ovoid. Antennæ elongate, reaching beyond the tip of tl e pronotum, slender, somewhat ensiform, flattened. Pronotum somewhat compressed on the sides, which are nearly parallel, diverging slightly at the posterior extremity; disk slightly arched transversely; median carina distinct, but not elevated; lateral carinæ obtuse and irregular on the front lobes in the form of obtuse ridges, converging posteriorly and becoming obsolete at the posterior sulcus, while on the posterior lobe, as they extend forward, they descend obliquely upon the sides as obtuse ridges, thus

showing two obtuse carinæ on each side directed forward and obliquely downward; the three transverse incisions subdistinct, each severing the median carina; the anterior lower angle of each side is distinctly and squarely notched; posterior margin obtuse-angled; entire surface granulose. Elytra and wings extend beyond the extremity of the abdomen, (the abdomen of my only specimen is much shriveled).

Color (dried).—Almost uniform brown; some dim fuscous dots on the elytra; femora pale externally, black internally, with yellow bands; posterior tibæ pale (probably rufous when living), with a broad dusky ring near the base. Wings (not spread) fuscous at the apex.

Dimensions.— ♀, Length to tip of elytra, 1.35 inches; elytra, 1.06 inches; posterior femora, 0.68 inch.; posterior tibiæ, 0.54 inch.

Remark.—In the form of the head and antennæ this resembles *Xiphocera*, but its general appearance is that of *Œdipoda*, especially the male of *Œ. carolina.*

Specimen received of Mr. Scudder, collected by Sumichrast in Mexico.

Acanthacara acuta, Scudd.

The top of the head to the tip of the vertex is nearly horizontal; tip of the vertex mucronate; the point of the spine bent downward; the under side of the cone is separated from the face by a deep upward notch, and has a short spine on this part pointing downward. Face very oblique, smooth, transversely convex. Maxillary palpi nearly twice as long as the labial; antipenultimate and final joints nearly equal in length and about one-third longer than the penultimate, terminal joints of all the palpi enlarged at the apex. Pronotum cylindrical, a little longer than the head, nearly straight on the dorsum; sides nearly parallel, subtruncate in front, squarely truncate behind, without carinæ; surface somewhat rugose. Mesonotum and metanotum similar to the abdominal segments.

Abdomen sub-cylindrical, about equal in width to the pronotum, continuing this width to the sixth segment, where it begins rapidly to decrease. Ovipositor somewhat broad at the base, tapering, curving moderately upward toward the extremity; apex pointed; about as long as the abdomen. Posterior femora rather short, not extending beyond the tip of the abdomen, about equal in length to the ovipositor; minutely dentate below on both the inner and outer margin. Antennæ about as long as the body, exclusive, of the ovipositor. Prosternum furnished with two rather long, slender, pointed spines. Posterior lateral margins of the meso- and metasternum elevated into sharp curved ridges.

Color.—Pale yellowish-brown, with a single broad fuscous stripe extending along the middle of the dorsum from the vertex to the extremity of the abdomen. Face, sides of the head, and prontum, and the femora a honey-yellow. The upper and lower spines of the cone of the head black; a narrow ring round the base of the antennæ and a half-ring around the inner side of the basal joint, black. The lower margin of the face (clypeus and mandibles) black; labrum white; palpi whitish. Antennæ with alternate rings of brown and white. The little globular (mouse-like) eyes dark-brown. Ovipositor yellowish-brown, pale at base, darker at the tip.

Dimensions.— ♀, Length from tip of vertex to extremity of the abdomen, 1.62 inches; from tip of vertex to tip of ovipositor, 2.26 inches; pronotum, 0.37 inch.; posterior, 0.77 inch.; ovipositor, 0.64 inch.

NOTES ON THE ROCKY MOUNTAIN RANGES IN COLORADO TERRITORY.

The Cordilleras of North America—the mountain-system of its western coast—are one with the Cordilleras of the southern continent, in having their general axis, a prolongation of the Andes, both as respects direction and actual topographical connection by the ranges and plateaus of Central America; while the fact that both are due to a common cause is shown by their bearing the same relations to the great basin or the Pacific Ocean, whose subsidence is undoubtedly connected with their origin.

The Cordilleras of North America consist of several chains and many ranges and table-lands, forming a system, because they are but the features and minor dependencies of one great general uplift of Western America—an elongated plateau upon whose face they are arranged in lines parallel with the axis or along the western side.

The two leading mountain-chains of the plateau are the chain of the Sierra Nevada and Cascade ranges and the chain of the Rocky Mountains; one standing directly upon its western edge; the other, the Rocky Mountain chain, forming the true crest of the great continental wave of upheaval, which, taken as a whole, is the Cordillera system. Between these chains, and even outside of them, are lesser chains, groups, and ranges.

The system has its greatest expansion between the thirty-sixth and forty-first parallels, where the breadth is about 1,350 miles, including the Coast ranges on the Pacific shores and the eastern slope of the plateau that descends from the foot of the Rocky Mountains to the proper basin of the Missouri, about 150 miles west of that river. The mountains alone are about 950 miles broad. This measurement is perpendicular to the general axis of this part of the system, whose direction may be taken at about north 15° to 20° west.

As this is the region of greatest breadth of the Northern Cordilleras, it is also the zone of greatest elevation, containing the highest peaks in the United States and the larger part of the area above 12,000 feet. The most powerful force of upheaval seems to have acted across the system in a belt 300 miles broad, whose central line runs west-southwest from Denver, Colo., to Monterey, 100 miles south of San Francisco. In crossing California it includes the highest parts of the Sierra Nevada, the Mount Whitney cluster of peaks, and those near the Yosemite; in Utah the highest parts of the Wasatch chain; while in Colorado the eastern end of the belt crosses the great meridional chain of the Rocky Mountains. In this Territory, therefore, we have the grandest uplifts of the chain.

Approaching Colorado from the east, rising gradually up 500 miles of monotonous plain, the mind is well prepared for the sensation that awaits one on reaching Denver. The South Platte River here flows nearly north. Denver, situated on its eastern bank, slopes toward the mountains.

Standing on the highest terrace of the city, one looks westward over its busy streets and crowded houses, and the green valley of the river, to the foot-hills twelve miles away, the beginning of the first range of the Rocky Mountains; then up at once 9,000 feet over 25 miles of rocky and pine-clad slopes and summits, to the great crest-peaks above all timber, shining, if it be early summer, with fields of snow, and stretching out far to the north and south, a procession of sharp, bright peaks 130 miles long.

This is the most eastern of the grand meridional ranges which together make up the Rocky Chain. The abruptness with which it rises from the plains—9,000 feet in 20 to 25 miles—the great length and height of its serrated crest, overlooking the sea of prairie for 200 miles, make it one of the most imposing mountain-façades in the world, a magnificent front to the Rocky Mountains. Being unnamed, we have called it the Front or Colorado range. Ascending this first ridge to one of its highest summits, Gray's Peak, still looking westward, it is at once evident that the great mountain-wave, whose face is so impressive from the plain, is but one of a number of parallel upheavals, with snow-capped crests, 20 to 30 miles apart. Between these ranges are great depressed troughs, sometimes developed as longitudinal river-valleys in the chain; sometimes cut by cross-ranges of lower elevation into basins known as "parks." The general depression west of the Front Range is divided into the South, the Middle, the North, and the North Platte Parks. Several sub-ranges, or minor upheavals, run north-northwest across the Middle Park. The South contains a number of very low ridges, while the North Park is in general a plain.

From Gray's Peak one looks across this trough of the "park" basins at the Park Range, so called, because it is the western wall of all the great "parks" stretching along them for 240 miles. Many parts of this range are capped with clusters of snowy peaks; the Mount Lincoln group, the best known, and the Blue River group, are the most remarkable.

Beyond this range only twenty miles west is the most elevated of all the upheavals, the Sawatch Range, set with a whole line of 14,000 ft. peaks. The deep valley between it and the Park range is occupied by the Eagle River, running north in deep cañons, and the Arkansas, flowing south through valleys. Where the Arkansas turns eastward across the chain, the Park range ends, and only twelve miles off to the southwest commences the Sangre de Christo range, whose lofty and sharp summits are everywhere visible from the plains of Southern Colorado. Its southern extension is not yet determined. Between the Sangre de Christo and the Sawatch is a long plain, known as the San Luis Valley.

West of the Sawatch Range, in the latitude of the South Park, are several short but very elevated northwesterly lines of upheaval, so crowded together as to form a group known as the Elk Mountains. It covers the region between the Grand and Gunnison Rivers. North of the Grand River, between it and the White, is a very high escarped plateau, separated from the Park Range by a long depression, the northern extension of that of the Eagle and Arkansas Rivers.

From these, the most elevated features of the Rocky Chain, high table-lands slope west to the great basin of Green River, which, in a succession of remarkable plateaus, extends from the mouth of the San Juan River 400 miles northward, its western side bounded by the Wasatch chain of mountains.

We see, therefore, that in crossing the Rocky Chain in Colorado from the plains westward, one generally finds in the first one hundred miles,

two or three long, prominent, well-defined ranges, with intervening depressions, bearing from north to north 25° to west; then, in the next seventy-five miles, shorter ranges and very elevated groups of mountains and tables, which fall off to the Green River basin.

The chain may be considered at from one hundred and seventy-five to two hundred miles broad.

Several cross-elevations connect the great ranges, and turn the continental divide or water-shed from one to another.

The Front or Colorado Range, beginning about twenty-five miles south of Pike's Peak, in latitude 38° 30′, longitude 105°, runs north 35° west ninety miles to the Mount Evans and Gray's Peak group, thence northward fifty miles to Long's Peak, and fifty miles farther to the Laramie Plains. Between Pike's Peak and Mount Evans the range is depressed and divided longitudinally, and the South Platte River cuts it. It has six peaks of the first order, that is, about 14,000 feet high. The southern end of the Medicine Bow is spliced onto the north end of the Front Range, overlapping it on the west side as far south as Long's Peak, where the well-defined dividing depression disappears. The North Park and the North Platte Park lie west of the Medicine Bow, between it and the Park range; while the South and Middle Parks lie between the Front and Park ranges.

The Park Range commences in latitude 38° 35′, longitude 105° 53′; runs north 25° west thirty miles to Buffalo Peak, thence north twenty-five miles to the Mount Lincoln group; then north 20° west to Mount Powell in the Blue River group. Here it loses its serrated crest, and falls off to an elevation of about 2,000 feet above the Middle Park; continuing north 17° west, with low, even outline (except at Rabbit-Ear's Peak) about sixty miles, when it again rises into groups of lofty rugged peaks overlooking the North and North Platte Parks at its eastern foot. The range is cut in one place by the Grand River passing through in a narrow cañon. It has only four peaks of the first order, all in the Mount Lincoln group; but a large number that are about 13,000 feet high. Its southern end is separated from the Sangre de Christo Range by the depression of the Arkansas Valley.

The axis of the Sangre de Christo is not a continuation of that of the Park Range, but lies parallel with it, and about twelve miles off to the southwest. Commencing in latitude 38° 26′, longitude 106, it runs south 30° east, in a continuous line of high sharp peaks, forming the eastern rim of the San Luis Valley. Between it and the plains on the east lies the well-defined, parallel, but lower Wet Mountain Range. Commencing in latitude 38° 22′, longitude 105° 20′, it runs south 30° east, with rounded outlines, for forty-five miles. The depression between it and the Sangre de Christo Range is the Wet Mountain Valley and the Huerfano Park.

West of the San Luis, Arkansas, and Eagle River Valleys is the Sawatch Range, ending at the north in the Holy Cross group, whose granite peaks burst abruptly through the surrounding sheets of sandstone. From this point, latitude 39° 30′, longitude 106° 33′, it extends south 20° east, a lofty precipitous range, having sixty to eighty miles of its crest elevated to 13,000 feet and set with many of the 14,000 ft. class. This highest part of the range rises directly from the Arkansas Valley 6,000 feet, in a distance of six miles.

On the west side of the Sawatch the depression parallel with it is drained to the south by Taylor's Fork of the Gunnison, and to the north by the Roaring Fork of the Grand River.

West of these valleys, and connected with the Sawatch by a high

cross-ridge, is the Snow-Mass Range of the Elk Mountain group. Beginning in latitude 39° 15′, longitude 107° 10′ near Sopris Peak, it runs south 45° east 50 miles. In the first thirty miles are five 14,000 ft. peaks. There are parallel, trough-like depressions on either side of this range throughout its entire length—the Roaring and Taylor's Fork Valleys on the east, and those of Rock Creek and East River on the west.

The western part of the Elk Mountain group has not been surveyed, nor the southern part of the Sangre De Christo and Sawatch ranges.

These are but notes on a mountain-region, in many respects the most interesting in America, which is at present the field of operations of this Survey.

Several permanent barometric stations, at high altitudes, have been established; one at 14,000 feet on Mount Lincoln, and one at Fairplay nearly 10,000 feet, and one at Cañon City about 5,000 feet above the sea; while the United States Signal-Service has in this Territory one station at 5,000 feet, one at 6,000 feet, and one at 14,000 feet on Pike's Peak. These are connected by spirit-level lines with the sea, and make, therefore, admirable bases for the hypsometrical survey of the region, which we are carrying on by mercurial barometer, trigonometric work, and aneroid observations on minor stations. The important points are measured with one or more mercurial barometers made by James Green.

The geological and topographical surveys were extended during the summer of 1873 over about 21,000 square miles. These surveys are based on a system of large primary and smaller secondary triangles expanded from measured bases, the whole resting upon four points along the foot of the mountains, Sherman, Denver, Colorado Springs, and Trinidad, whose latitudes and longitudes have been carefully determined for us by the United States Coast Survey. The positions of the trigonometric stations on the peaks have been deduced from these.

The maps of these mountains, now in progress, are on a scale of two miles to one inch, and drawn in horizontal contour-lines 200 feet apart.

In the following tables are given the approximate heights and geographical positions of some of the principal peaks of the mountain-ranges and points in the valleys of the region surveyed last summer. The final results of our computations will be published in the Annual Report of the Survey.

JAMES T. GARDNER.

Approximate elevations and geographical positions of prominent points.

Location.	Latitude.	Longitude.	Elevation above sea.
ON THE PLAINS AT THE EASTERN FOOT OF THE MOUNTAINS.	° ′ ″	° ′ ″	*Feet.*
Denver K. P. R. R. Depot	39 45 0.67	104 59 23.40	5,084
Denver U. S. sig. service barometer			5,132
Colorado Springs, D. & R. G. R. R. depot	38 50 0.28	104 49 7.65	5,872
Pueblo			4,600

Approximate elevations, &c.—Continued.

Location.	Latitude.	Longitude.	Elevation above sea.
IN THE FRONT OR COLORADO RANGE.	° ′ ″	° ′ ″	*Feet.*
Long's Peak	45 15 19	105 36 37	14,150
Mount Audubon			13,172
Mount Parry			13,212
Arapahoe Peak	40 1 13	105 38 39	13,412
James's Peak	39 51 10	105 41 9	13,262
Torrey's Peak	39 38 37	105 49 0	14,249
Gray's Peak	39 38 5	105 48 46	14,254
Mount McClellan, (near Gray's)			13,332
"Chief"	39 40 34	105 31 7	11,716
Mount Evans	39 35 21	105 38 20	14,270
Mount Rosalie	39 35 20	105 39 0	14,260
Platte Mountain	39 15 0	105 6 0	9,201
Plateau north of latter			8,041
Plateau south of latter			8,525
Tarryall Mountain	39 14 0	105 30 0	12,354
Pike's Peak	38 50 26	105 2 22	13,985
Cameron's Cone			11,408
Cheyenne Mountain			9,896
IN THE CROSS RANGE, BETWEEN MIDDLE AND NORTH PARKS.			
Parkview Mountain	40 19 51	106 7 51.7	12,232
IN THE MIDDLE PARK SUB-RANGE.			
Mount Byers	39 51 55	105 56 33	12,776
Ute Peak			11,866
IN THE MIDDLE PARK.			
At the Hot Springs			7,660
Grand Lake, (head of park)			8,000
Junction of Blue and Grand Rivers			7,060
IN THE CROSS RANGE, BETWEEN MIDDLE AND SOUTH PARKS.			
Mount Guyot	39 28 0	105 56 0	13,452
Mount Silver-Heels	39 20 0	106 0 0	13,794
IN THE PARK RANGE.			
Mount Powell	39 45 40	106 20 8	13,282
Quandary Mountain	39 24 0	106 6 0	14,047
Mount Lincoln	39 21 8	106 6 25	14,183
Buckskin Mountain	39 20 0	106 8 0	13,951
Station 52	39 14 0	106 10 0	14,055
Horse-Shoe Mountain	39 12 0	106 10 0	13,780
Buffalo Peak	38 59 0	106 7 0	13,482
IN THE WET MOUNTAIN RANGE.			
Greenhorn Mountain	37 52 52	105 0 33	12,117
IN THE SANGRE DE CHRISTO RANGE.			
Hunt's Peak	38 23 0	105 56 29	12,333
Mount Rito Alto	38 13 7	105 45 7	12,876
Christone Peaks	37 58 19	105 34 43	14,120
Station 16	37 48 0	105 39 0	13,425

Approximate elevations, &c.—Continued.

Location.	Latitude.	Longitude.	Elevation above sea.
IN THE SOUTH PARK.	° ′ ″	° ′ ″	*Feet.*
Fairplay	39 25 31	106 19 0	9,854
Salt Works	38 57 0	105 56 0	8,800
Head of the Platte Cañon	38 54 0	105 27 0	8,050
IN THE SAWATCH RANGE.			
Holy Cross Mountain	39 28 4	106 28 37	13,540
Massive Mountain	39 11 0	106 28 0	14,213
Mount Elbert	39 7 0	106 26 0	14,222
La Plata Mountain	39 2 0	106 28 0	14,188
Grizzly Peak	39 2 0	106 36 0	13,848
Mount Harvard	38 55 31	106 19 0	14,270
Station 75	38 49 20	106 22 30	12,981
Mount Yale	38 50 40	106 18 50	14,041
Mount Princeton	38 44 59	106 14 18	14,057
Station 38	38 41 11	106 37 4	13,049
Mount Ouray	38 25 24	106 13 16	13,930
Mount Shavano	38 37 21	106 14 6	13,980
Station 45	38 35 37	106 18 0	13,584
Mount Antoro	38 40 35	106 14 30	14,132
ON THE ARKANSAS RIVER.			
Tennessee Pass, (head of river)	39 21 0	106 20 0	10,223
Twin Lakes, (foot of lower lake)	39 4 0	106 19 0	9,219
Near mouth of Chalk Creek	38 45 0	106 04 0	7,901
IN THE ELK MOUNTAIN GROUP, SNOW-MASS RANGE.			
Sopris' Peak	39 15 54	107 09 50	12,308
"Black Pyramid"	39 9 0	107 04 40	13,884
Snow-Mass Mountain	39 7 12	107 03 44	13,853
Maroon Mountain	39 4 30	106 59 20	13,892
"Sta. E."	....	....	13,699
Castle Peak	39 0 30	106 38 40	13,995
Italian Peak	38 56 35	106 45 0	13,101
White Rock Mountain	38 58 30	106 55 10	13,517
Teocallé	38 57 40	106 53 0	12,944
Gothic Mountain	38 57 30	107 00 30	12,378
Crested Butte	38 53 0	106 56 20	11,903
Uncompahgre Peak	38 4 25	107 27 30	14,540
Station 33	38 1 30	106 55 15	13,783
Station 34	38 16 28	106 51 49	12,150
IN SAN LUIS VALLEY.			
S. E. corner of township 44, N. R. 8 E. meridian and base of New Mexico	38 01 28	106 1 16	
Saguache	....	....	7,632

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vertebræ, and that the dorsal fin commences about an inch behind the line of the posterior border of the cranium. It also exhibits the strong sculpture of the surfaces of the latter to consist of narrow inosculating ridges, inclosing larger and smaller pit-areas.

The specimen exhibits this sculpture to be very marked on the opercular, suborbital, parietal, frontal, and sublingual bones, the only ones where it displays the surface. The branchiostegal radii number twelve, the upper large and wide. The subopercular is turned up anteriorly as in *A. calva*, and is thickened on the border of the suture with the interoperculum. The sublingual bone has much the form of that of *A. calva*, but is rather wider and there more abruptly contracted than in a specimen of the latter before me. The orbit is smaller relatively than in *A. calva*.

It is uncertain whether this and the preceding species possessed the dentition of *Amia* or *Pappichthys*, Cope, as the mandibular bone is partially broken away on the inner side. Some of the teeth are of small size and abruptly contracted near the apex, so they may belong to the inner row of the true *Amia*, which is wanting in *Pappichthys*.

The fourth specimen displays the ventral fins and the characteristic femoral supports. The fins originate about an inch behind the line of origin of the dorsal fin in a specimen of $0^{m}.055$ depth of body. The scales exhibit also the dermal margin with truncate posterior outline seen in the existing species; this character is chiefly seen on the abdominal surfaces. There are thirty-five vertebræ between vertical lines drawn from the beginning of the dorsal fin and end of the basis of the anal fin; and thirty-two dorsal radii in the same interval; anal radii, nine; ventrals, six.

Measurements.

	M.
Depth of body to vertebræ (No. 1)	0.045
Length of four dorsal vertebræ (No. 1)	.019
Depth of one dorsal vertebra (No. 1)	.010
Length of head to free border of operculum (No. 2)	.124
Depth of operculum	.032
Length of head on vertex	.093
Length from end of muzzle to orbit	.032
Length of orbit	.012

AMYZON PANDATUM, *sp. nov.*—Form very stout; the body deeper in relation to its length than in the known species of *Amyzon*: greatest depth just in front of dorsal-fin, and two-fifths the length to basis of caudal. Length of head one-third the latter. Spines of premaxillary causing a protuberance above the end of the muzzle, as in many existing *Catostomi*. Mouth slightly inferior; end of muzzle obliquely truncate in profile. Dorsal fin elongate elevated in front; radii mostly short; caudal openly emarginate; anal not very elongate in either direction; ventrals below first rays of the dorsal. Radii, D., III, 31; A., II, 11. Scales, $\frac{10\text{-}12}{10\text{-}11}$, with concentric and radiating lines well developed. Vertebræ, 6, 17, 10.

Measurements.

	M.
Total length	0.112
Length to basis of caudal	.093
Length to basis of anal (axial)	.071
Length to basis of ventral (axial)	.041
Depth of caudal peduncle	.015
Depth of anterior anal rays	.022
Depth at occipital crest	.030

In another rather larger specimen, which agrees with that above described, the lateral line is well preserved.

From the South Park, Colorado.

AMYZON FUSIFORME, *sp. nov.*—Represented by a very small fish, which exhibits fully ossified bones, but may be immature. It exhibits characters quite distinctive, although the caudal peduncle, anal fin, and opposite parts of dorsal are wanting. The head is very perfectly preserved, and is of a regularly short-conic form, with equal lips. The attenuated muzzle shows none of the obtuseness characteristic of the other Amyzons. Another peculiarity is seen in the ventral fins, which stand below the eighth instead of the first articulated ray. They are evidently in their normal position, and the ribs are undisturbed. The pectorals extend more than half-way to the ventrals. There are seven neural spines in front of the first interneural, and sixteen between the latter and the first interhæmal. In this, as in the other species, the postclavicle is rather elongate and acute, and the parapophysial element of the anterior vertebral mass extends as far down as the line of the middle of the orbit.

Measurements.

	M
Length of head	0.0095
Length to line of ventrals	.0180
Length to line of anal	.0239
Depth at first dorsal ray	.0105
Depth at occiput	.0070

ON THE CRANIAL AND DENTAL CHARACTERS OF MEPHITINÆ, WITH DESCRIPTION OF MEPHITIS FRONTATA, N. SP. FOSS.*

By Dr. Elliott Coues, U. S. A.

DENTAL FORMULÆ.

$$\text{I.}\ \frac{3\text{–}3}{3\text{–}3};\ \text{C.}\frac{1\text{–}1}{1\text{–}1};\ \text{P.}\frac{3\text{–}3}{3\text{–}3};\ \text{M.}\ \frac{1\text{–}1}{2\text{–}2}\frac{=16}{18}=34:\ \left\{\begin{array}{l}\textit{Mephitis,}\\ \textit{Spilogale.}\end{array}\right.$$

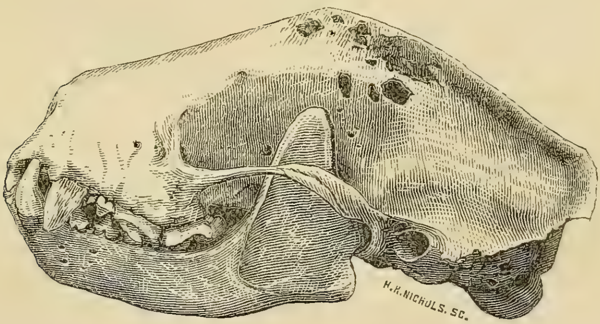
$$\text{I.}\ \frac{3\text{–}3}{3\text{–}3};\ \text{C.}\frac{1\text{–}1}{1\text{–}1};\ \text{P.}\frac{3\text{–}3}{3\text{–}3}\ \text{or}\ \frac{2\text{–}2}{3\text{–}3};\ \text{M.}\ \frac{1\text{–}1}{2\text{–}2}=\frac{6}{18}\ \text{or}\ \frac{14}{18}=34\ \text{or}\ 32:\ \textit{Conepatus.}$$

MEPHITIS FRONTATA, Coues, n. sp. foss.

Diag.—Skull extremely high in the middle; the profile of the upper outline very rapidly descending in a nearly straight line from this point to the occiput and muzzle. Greatest depth of skull without jaw little less than half its length. Zygoma highly arched; the bone in front compressed vertically instead of laterally.

Locality of remains.—Bone-caves of Pennsylvania.

Fig. 1.



This species is founded on a skull, No. 2232 of the Smithsonian Museum, obtained by Professor Baird in the bone-caves of Pennsylvania. The animal was a true *Mephitis*, as evidenced by the functionally-developed anterior upper premolar and shape of the jaw. The most remarkable peculiarity will be seen at a glance in the accompanying illustration of the skull in profile. Though the frontal region is tumid throughout *Mephitinæ*, there is seen in the recent species nothing like the protuberance and angulation of the vertex of *M. frontata*. The prominence is also decidedly more posterior; it is something over and above the general tumidity of the interorbital region of recent *Mephitis*; the

* Based on the material in the Museum of the Smithsonian Institution.

shape is rather as a *Gulo ;* but even the profile of the latter is here exaggerated. The prominence appears to be mainly due to enlargement of the frontal sinuses, as may be seen in this specimen, on which the outer tablet of the skull is abraded in places, exposing the interior. With this general elevation is associated a notably higher arch of the zygoma; but the bone itself is slenderer than in recent species at its anterior portion, where it is curiously narrowed vertically instead of being laminar throughout. None of these characters obtain in any of the numerous recent skulls examined, notwithstanding the great variability of the latter.

The animal was the size of the common species. The skull in general bulk is intermediate between various specimens of *M. mephitica.*

The excellent figure, engraved by Nichols, of Washigton, from an photograph on wood by Smillie, renders further description unnecessary.

MEPHITIS MEPHITICA, Bd. ex Shaw.

(*M. americana* or *chinga*, of authors.)

The cranium of no animal with which I am acquainted varies more than that of the skunk, and few exhibit such remarkable differences, independently of age and sex. Some specimens are more than a fourth larger than others, and twice as heavy; and there is a corresponding range of variation in contour. Compared with an ordinary ratio of osteological variability, the discrepancies are almost on a par with those exhibited by the coloration of the animal when set over against the more constant markings of most animals. In the series of twenty or thirty skulls examined, I find that the western ones, and especially those from the Pacific coast, representing *occidentalis* of Baird, are, as a rule, larger and heavier than others, more widened and flattened behind, with stronger and more flaring sagittal and especially occipital crests. But these extremes shade insensibly into an ordinary pattern, and I can draw no dividing line. Tables of measurements would show these variations, though they would scarcely render that realizing sense of the discrepancies that is found by laying the two extremes side by side. An average cranium, No. 3816, from New York, is selected for description, in the course of which the variations of the whole series will be brought under review.

The greatest zygomatic width is to the length as 1 to 1.55, or slightly less than two-thirds such length. A similar proportion is generally preserved. Viewed from above, the cranium presents a short, tumid, rostral portion, high at the nose, tapering on either side, but with a protuberance indicating the course of the canine tooth in the bone, subtruncate in front, with large subcircular nasal aperture, in this view much foreshortened. The rostrum is about a third of the whole length, if measured from extreme front to anterior root of zygoma; the zygoma, and then the rest of the skull, being, respectively, another third. In other skulls, the rostrum is shorter than this, and less vaulted. The general convexity of the rostrum continues on to the forehead, in the broad, smooth, interorbital space. Supraorbital processes are very slight, being only indicated in a little bulging at the front, where the anterior forks of the sagittal crest come to the brim of the orbit. There is thus scarcely any definition of the orbit from the general temporal fossa. The point of greatest constriction of the skull is considerably behind

the supraorbital process, just about half-way from end of rostrum to occiput, and opposite the apex of the mandibular coronoid, when the jaw is closed. It is a gradual pinching-together of the sides of the cranium for some distance, rather than an abrupt constriction at a particular point. It is sometimes unsymmetrical, one side being more emarginate than the other; is sometimes scarcely narrower than the interorbital space, sometimes about three-fourths as much. Back of this point, the skull widens rapidly to the hinder root of the zygoma and mastoid; the latter being the broadest point of the skull proper, separated from the former by an emargination, in which lies the opening of the meatus auditorius not visible from above. From each mastoid, the skull narrows in an approximately straight line backward and upward for a distance, and then ends with a straight-across contour, more or less emarginate on the median line. This whole posterior boundary, representing the lambdoidal crest, is extremely variable, not only according to age, but fortuitously. In some skulls—those with the broadest back part and most flaring occipital crest—there is a deep emargination in the middle line of the skull, boldly salient angles on either side of this, and a concave outline thence to the mastoid. This occipital flange hides all the parts beneath it. For the rest, the top of the skull shows a sagittal crest, (only in very young skulls a raised tablet,) well marked in all but young examples, forking anteriorly (at or a little in advance of the point of greatest constriction) to send a curved leg outward to either supraorbital process. Aside from this crest and the occipital one, the general cranial surface is vaulted. The zygomatic arches, viewed above, show the point of widest divergence near their posterior roots, whence they gradually and regularly converge forward with slight curve.

Viewed in profile, the skull shows its highest point at the interorbital space, whence it slopes gradually with a general slight convexity to the muzzle and occipital protuberence. This highest point is generally a little, sometimes decidedly, in advance of the middle of the skull. The frontal profile may acquire a slight concavity, and the opposite one may be slightly sinuous, owing to irregularity of the sagittal crest. The muzzle is cut squarely off, with an obliquity of perhaps 30 degrees from the perpendicular. The zygoma shows but a slight upward arch, and no beveling or special curve to define the portion of the orbit which it represents. It is laminar, narrowing midway, stoutest near posterior root. The anteorbital foramen* is a short perforation of a thin upper plate of its anterior root; behind, the glenoid fossa presents rather forward than downward. The prominent orifice of the meatus presents laterally between the root of the zygoma and the mastoid, which latter is a protuberant but blunt process immediately behind the meatus. Behind this, there is an emargination, terminated by the prominent downward-projecting paroccipital; back of this, the semicircular outline, foreshortened, of the occipital condyle appears.

The back of the skull is a subtriangular face, flat and perpendicular in general superficies, bounded above by the overhanging sagittal crest; either lateral corner being the prominent paroccipital, between which appear the faces of the oblique condyles, the upper border of the foramen being transverse with a slight curve.

The skull from below shows a broad, flat, palatal surface for about two-fifths of its total length. The palate ends about opposite, or a little

*As a curious but not very infrequent anomaly, this foramen is sometimes divided into several separate canals, through which branches of the facial nerve pass out apart from each other. I have observed the same thing in *Conepatus*.

back of, the posterior molars. This terminal shelf, representing the emargination between the pterygoids, is always broad and quite transverse; but the edge varies greatly in detail. It is commonly transverse, with a small median, backwardly-projecting point, producing a double emargination. It may be simply a broad curve, or it may present a median nick. The latter case is oftenest observed in specimens from the West, and constituted a chief character upon which *M. occidentalis* rested; but, with a larger series than Professor Baird examined, it is shown to be wholly fortuitous. The general shape of the palate is triangular; including the teeth, its greatest width behind is about as much as its length; anteriorly, it presents broad but short incisive foramina, scarcely reaching opposite the molars. The depth of the pterygoid emargination is considerably less than the length of the palate. The pterygoids are simply laminar, with strongly hamulate ends. They are usually parallel, but sometimes converge a little posteriorly, making the inclosed space club-shaped. The general surface of the base of the skull behind is quite flat, owing to slight inflation of the bullæ. These are decidedly convex only at one place, interiorly, elsewhere flat, and outwardly produced to form a tubular meatus. Traces of separation from surrounding parts long persist; at least, in front. About the bullæ are seen the following foramina: one in advance, just inside the glenoid fossa; two at the anterior extremity of the bulla; three along its inner border; one more exterior, near the mastoid; one far posterior, in the occipital. The basi-sphenoid suture, early obliterated, is straightly transverse in advance of the middle of the bullæ. The general basilar area is flat, narrowing forward, unmarked, or with merely a slight median ridge. The border of the foramen magnum represents a deep emargination of the posterior border of this area, with the condylar protuberance on either side.

All the bones of the skull finally co-ossify, excepting, of course, the mandible, and most are joined at a comparatively early age. The periotic and internasal sutures persist the longest; the latter after the nasals are consolidated with the maxillaries, and the former after the basi-spheno-occipital suture is obliterated. When found separate, the nasals are seen to be regularly concave along their exterior border, truncate anteriorly, with a produced antero-lateral corner, and received by a pointed process in a recess of the frontal. The intermaxillary bone forms less than half of the general naso-maxillary suture. The maxillary extends within a short distance of the supraorbital protuberance. The malar is rather small, and fuses early with the rest of the zygomatic arch. The occipital bone is rather late to co-ossify; the supraoccipital is then seen to represent most of the lambdoidal crest, reaching, on either hand, from the median line half-way to the mastoid process; thence crossing this crest to the paroccipital, whence the suture runs on the floor of the skull along the border of the periotic by the foramen lacerum posterius to the basi-sphenoid; thence straight across the median line.

The lower jaw in *Mephitinæ* is never locked, as far as known, in the glenoid by the clasping of the condyle in the embrace of the fossa, as is the rule, in adult life, in *Meles* and in *Taxidea*, and as sometimes occurs in the Otters, (*Lutrinæ.*) The ramus of the mandible is stout, and nearly straight along the tooth-bearing portion; the symphysis is thick, short, abruptly ascending obliquely forward. Between the ramus proper and the angle of the jaw, the lower border is decidedly emarginate, and the angle itself is scarcely or not at all exflected (*cf. Conepatus*). The angle itself is obtuse, and there is a decided neck in the outline thence to the

condyle. The condyle is horizontal, transverse, very narrow, and acute internally; on the outer half, its articular surface looks upward; on the inner half, backward. The coronoid process rises straight and high, nearly uniformly tapering to the apex, a perpendicular from which falls decidedly in advance of the condyle (*cf. Conepatus*). The general muscular impression on its outer face is well marked. It is pointed below, and reaches forward on the ramus to a point underneath the last lower molar (*cf. Conepatus*).

As remarked under the head of *Conepatus*, the dental formula of the three genera of *Mephitinæ* does not, in point of fact, differ. The difference is *nil* as between *Mephitis* and *Spilogale*, in *Conepatus*, a supposed lesser number of teeth is only true in the very small size of the abortive, deciduous, or, at any rate, not functionally developed anterior upper premolar. In *Mephitis*, also, the tooth may be very small, or even abortive, on one or both sides of the jaw; it is, however, normally present and readily recognizable.

Selecting an average skull, of middle age, with fully-developed, yet little-worn, dentition, (for in very old skulls the teeth are so ground down as not to furnish fair characters,) we observe the following points:

The back upper molar is the largest of the grinders, about as long as broad, quadrate, with rounded inner corners, and entirely tuberculous. It is completely divided across lengthwise by a sulcus, on the outer side of which is a narrow portion, much higher than the broad inner portion, and separated from it not only by the groove across the face of the tooth, but by a nick in the hinder border. This elevated outer moiety is oblique on its face from the general level of the dentition; it runs to a point at its fore and hind end, and has a central, slightly-excavated field, with irregular-raised boundary. The flatter inner moiety of the tooth is chiefly occupied by a large antero-internal tubercle, separated by a curved sulcus from a posterior raised margin. The next tooth—back premolar—differs altogether from the same flesh-tooth in the *Mustelinæ*. It is relatively smaller, and has not a prominent isolated antero-internal fang. On the contrary, it is triangular in general outline, the inner corner of the triangle representing the fang of the *Mustelinæ* just named; this is cuspidate, but this whole inner moiety is low and "tuberculous" in comparison with the elevated and truly sectorial character of the rest of the tooth; for, viewed in profile from the outside, the tooth seems wholly sectorial, with two cusps, an anterior, produced acute one, and a posterior, shorter and obtuse, separated from the other by an acute re-entrance. Taken together, these two external cusps make the trenchant edge of the tooth. The next premolar is immediately and very markedly reduced in size; it is a small, simple, two-rooted, conical, acute cusp, with a slight posterior "heel" and well-marked cingulum on the inner side. The next—anterior—premolar is exactly like the foregoing, but very much smaller still, and single-rooted; it sometimes aborts. In very old skulls, the foregoing descriptions can hardly be verified. The back molar wears down to a perfectly smooth face, with raised inner and outer borders; the flesh-tooth loses its edge and inner cusp, and becomes almost tuberculous throughout; the other premolars become mere stumps The canines offer no points for remark. Of the upper incisors, the lateral pair is much larger than the rest, though not longer. I fail to appreciate any tangible difference in this respect between *Conepatus* and *Mephitis*. The tips of the teeth all fall in the same line; they are even and regular; the ends are obscurely lobate. These teeth start from the sockets quite obliquely, but soon turn perpendicularly downward, with an appreciable elbow.

In the lower jaw, the back molar, as usual, is small, simple, circular, single-rooted, with a central depression and irregularly-raised margin. The next molar is much the largest of the series, and very notably different from the same tooth in *Mustelinæ*. It is fairly sectorial throughout; for the back portion, though lower than the rest, is decidedly of the same character as the other part. This tooth consists of five cusps: a posterior pair, side by side, inner and outer, of equal size and similar shape; a middle pair, side by side, the outer of which is larger and sharper than the inner; and a single anterior cusp. The latter forms, with the exterior middle cusp, the main trenchant edge of the tooth. The interior middle cusp is a higher development of the "heel," more or less prominent on the inner face of the main cusp of the musteline tooth. The posterior pair of cusps is the low tuberculous part of the tooth in *Mustelinæ*. The first premolar from behind is a simple conical cusp, two-rooted, with evident heels, both before and behind, and a well-marked cingulum. The next tooth is similar, but smaller, with less of a girdle, and scarcely an anterior heel. The anterior premolar is like the last, but smaller still, and single-rooted. I have not seen its abortion. In very old skulls, the two molars become ground almost perfectly flat, and the premolars become stubby cones. The lower canines are shorter, relatively stouter, and more curved than the upper ones; there is usually quite an elbow at the point of greatest curve. The inferior incisors are more nearly of a size than is usual in *Mustelinæ*, and more regular, *i. e.*, none are crowded out of the general plane; but this is a matter of degree only. The outer pair is larger than the rest; viewed from the front, they widen from base to tip, and the apex is emarginate. The next pair sets a little back from the general plane; for, though their faces are generally quite flush with the others, yet their greater thickness causes them to protrude behind. All the under incisors are approximately of one length. The cutting-edge of the outer pair is oblique; of the others, horizontal. The cutting-edge of the outer pair is nicked, as already said; and the front faces of the rest are marked by a sulcus ending in a slight bilobation of their cutting-edges.

SPILOGALE PUTORIUS, Coues ex Linn.*

Mephitis zorilla, bicolor or *interrupta* of late authors.

Numerous specimens before me, labeled "*bicolor*" and "*zorilla*," exhibit surprising variation in size and shape, without, however, warranting presumption that they are not all of the same species. Independently of the usual differences according to age, there is a remarkable range of variation in the width and depression of the skull behind and development of the occipital crest. An average specimen is selected for description, in which the range of variation will be also noted. Comparative expressions used have reference to the skull of *Mephitis mephitica*.

The skull is smaller than that of *M. mephitica;* excepting one abnormally large example, all are much less in every dimension than the smallest (adult) skulls of *M. mephitica* which I have seen. Viewed from above, the muzzle appears more tapering, if not also relatively shorter; the angle of obliquity of truncation of the nasal orifice is much the same. Supraorbital processes are small, but well defined, as acute eminences, prolonged from well-defined ridges of bone divaricating from the sagittal crest. This crest is a single and acute ridge in adult

Viverra putorius, L., Syst. Nat., i, 10th ed., 1758, p. 44. (Based on Catesby.)

skulls; in young ones, it is a tablet of bone, the sides of which separate almost at once from the occipital protuberance. There is little, if any, postorbital constriction of the skulls; the least width there being little, if any, less than the interorbital width. The lateral divergence of the zygomata is much as in the last species. Behind, the skull is notably widened and flattened, almost as in *Taxidea* the intermastoid diameter being relatively much greater than it is in either *Conepatus* or *Mephitis;* in fact, it is not very much less than the interzygomatic width, in some cases, at least. The occipital crest is strongly developed, and its outline is characteristic in the great convexity of contour on each side and deep median emargination; in other genera the median emargination is always slight, sometimes *nil;* and the lateral outline from the mastoid to the point where the supraoccipital bones leave the general occipital crest is about straight—if anything, concave.

A notable peculiarity appears in the profile-view of the skull. The dorsal outline in *Mephitis mephitica* is strongly convex, with a high point about the middle, and this is carried to an extreme in *M. frontata;* in the present case, the same outline is nearly straight from the ends of the nasals to near the occipital protuberance; in fact, the skull is as flat on top as an Otter's, and flatter than a Badger's. The zygomata are strongly arched upward, with a regular curve throughout, instead of being highest behind; the prominence of the bulla ossea on the floor of the skull is sufficient to bring this part fairly into view from the side, as is scarcely the case in *M. mephitica;* this feature is also due, in part, to an abbreviation of the mastoid process, which is hardly at all produced downward.

On the floor of the skull, the principal feature is the width behind, which, being simply co-ordinate with the general lateral dilatation already noticed, requires no further comment. The paroccipitals are very small—in fact, mere nibs of bone, hardly able to bear the term "process." There is also a point in connection with the bullæ auditoriæ. These are not only more bullous at the usual point of greatest inflation, but behind this, the part that reaches between the lateral elements of the occipital bone and the lateral portion of the lambdoidal crest has also a general smooth convexity instead of an irregular concavity. The bony palate ends in the same relative position as in *M. mephitica*, and shows the same variation in the character of the edge of this shelf.

The mandible, though, of course, proportionally smaller than in *M. mephitica*, is identical in shape, contrasting equally well with the peculiarities of *Conepatus*, elsewhere mentioned.

The smaller size aside, there is scarcely anything in the dentition of this species calling for comment in comparison with *Mephitis*. The anterior premolar is well developed, and, as far as I can see, the dentition is, in other respects, nearly identical with that of *Mephitis;* the upper sectorial tooth, (posterior premolar,) however, has the cusp of its inner moiety rather a pointed process of the border itself than a conical cusp, surmounting this inner part.

It should be noted that in one specimen, as an abnormality, the anterior upper premolar has aborted entirely on the right side, though present on the left; while the lower jaw of the same specimen shows an abortive *posterior* premolar on the left side. But, in general, in *Mephitinæ*, abortion or other irregularities of dentition are less frequent than in the *Mustelinæ*, where the smaller teeth are more crowded.

CONEPATUS MAPURITO, Coues ex Gm.*

Mephitis (Thiosmus) mesoleucus, LICHT., and most late authors.

In the following description, reference is had to the same parts of *M. mephitica*, to which all expressions of comparison apply. The account is based mainly upon No. $\frac{1881}{790}$, Mus. Smiths. Inst., from Texas, but several other specimens are examined at the same time.

Viewed from above, the muzzle is notably tapering—decidedly more so than in *M. mephitica*, though the calibre at the base of the zygomata is even greater. The nasal aperture is much less foreshortened in this view. Supraorbital processes are barely, or not at all, recognizable; the prongs of the sagittal crest are faintly indicated or entirely inappreciable. The point of greatest constriction of the skull (about midway between muzzle and occiput) is well marked and abrupt; the skull immediately swelling behind it, forming a decided projection into the temporal fossa, hardly or not seen in *M. mephitica*. The cranial dome is rather higher and fuller. The zygomatic arches are comparatively shorter, more divergent, and more regularly curved. In profile, the differences are more striking. The highest part of the skull is back over the cranial dome, not at the interorbital space; the slope is but slight thence to the occipital protuberance, but is long and regular from the same spot to the incisor teeth; for so great is the obliquity of the nasal orifice that the end of the muzzle comes into this general curve, instead of rising, with slight obliquity, from the teeth to then bend abruptly backward at an angle. None of the specimens, unluckily, are young enough to show the nasal sutures; but I have no doubt that these bones, if not also the neighboring part of the maxillaries and intermaxillaries, will be found to afford good characters. The anteorbital foramen (as in other species, sometimes subdivided into several separate canals) is farther forward and higher up, piercing a thicker zygomatic root, and consequently being rather a tube than a hole. The zygomatic bones are slenderer and less laminar than in *Mephitis*. The arch, as a whole, is shorter and more anterior; in skulls of the same length laid together, the back roots of the arch in *Conepatus* fall in advance of the other when the muzzles are together. Viewed from behind, the occipital surface is much higher and narrower: thus the distance from the bottom of the foramen magnum to the occipital protuberance is greater than the interparoccipital width; in *Mephitis*, it is, if anything, less. Beneath, the palate is seen to end some distance back of a line drawn across behind the molars; the pterygoids and contained interspace are correspondingly shorter than in *Mephitis*, in which the palate ends more nearly opposite the back molars. The edge of the palatal shelf is simply transverse in some specimens, while in others it shows a little median process backward, and we may presume that in other cases it is nicked, for all this variation is now well known to occur in both *Mephitis* and *Spilogale*.

The lower jaw gives excellent characters. The angle of the mandible is strongly exflected and the emargination between this and the condyle is slight. The coronoid process rises with considerable backward obliquity, with a very convex anterior border, and concave posterior one, carrying the apex of the bone backward to a point nearly or directly over the condyle.

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* *Viverra mapurito*, GM., Syst. Nat., i, 1788, p. 88.

A peculiarity of the dentition of *Conepatus* has been unduly exaggerated by some authors who assign a different dental formula, (*pm.* $\frac{2-2}{3-3}$ as against *pm.*$\frac{3-3}{3-3}$ in *Mephitis.*) But the supposed wanting anterior premolar is present as a rule; though it is always minute, probably never functionally developed, and deciduous or abortive on one or both sides. I see this small tooth plainly in two skulls before me, but do not find it in a third; in which last, there is instead an unusul diastema between the canine and the nearest premolar. This point disposed of, nothing in the dentition of *Conepatus* calls for special remark. The detailed account given under the head of *Mephitis mephitica* is here equally applicable.

Vertebræ, C., 7; D., 16; L., 5; S., 3; Cd., 18. (*Gerrard.*)

ANCIENT RUINS IN SOUTHWESTERN COLORADO.

By W. H. Jackson.

In the extreme southwestern corner of Colorado Territory, west of the one hundred and eighth degree of longitude, are groups of old ruined houses and towns, displaying a civilization and intelligence far beyond that of any of the present inhabitants of this or adjacent Territory.

It will be my endeavor, in the few pages following, to describe these with as much minuteness and circumspection as a very hasty trip enabled me to observe; depending more upon the pictorial illustrations accompanying this article for clear exposition of the subject than upon my choice of words.

Extending around the sources of the Rio Grande del Norte is one of the grandest uplifts of the whole Rocky Mountain chain, the Sierra San Juan. The drainage from its southern face supplies the half-dozen streams which go to make up the Rio San Juan, flowing westwardly into the Colorado of the West. To the southwest, standing isolated and alone, is another great mass of trachytic mountain-peaks, known as the Sierra La Plata, from which flow the Rio La Plata and the Rio de los Mancos, the most western of any importance of the northern tributaries of the San Juan.

Although ruins in considerable number and importance were said to exist along the Rio Las Animas and San Juan; we did not think it best to spare any of the little time at our disposal for their investigation. Our object being to find those in which the picturesque predominated and were the least known, we directed our course to the westward, having obtained reliable information of the existence of some which would come up to our anticipations. The Rio de los Mancos, (from what circumstance so named I have not been able to learn,) rising in two principal forks among the western foot-hills of the Sierra La Plata, flows southwesterly through fertile and beautiful valleys to a great table-land, known as the "Mesa Verde," and entering, flows directly south through it, to the valley of the San Juan, and then turning west again joins that stream near the crossing of the boundary-lines of the four Territories.

Commencing our observations in the park-like valley between the *mesa* and the mountains, we find that the low benches which border the stream upon either side bear faint vestiges of having, at some far-away time, been covered with dwellings, grouped in communities apparently, but now so indistinct as to present to the eye little more than unintelligible mounds. By a little careful investigation, however, lines of foundations of great squares of blocks of single buildings and of circular inclosures can be made out; the latter generally with a depressed center, showing an excavation for some purpose. The greater portion of these mounds were now overgrown with artemisia, piñon-pine, and cedar, concealing them almost entirely from casual observation. We found the surest indication of the proximity of these old ruins by the great quantities of broken pottery, which covered the ground in their

neighborhood; the same curiously indented, painted, and glazed ware found throughout New Mexico and Arizona. It was all broken into very small pieces; none that we could find being larger than a silver dollar. We had no opportunity to make any excavations about these old mounds; but such little scratching around as we could do developed nothing new below the surface, that which covered the ground having been broken and scattered since the demolition of the homes of the makers. Nowhere among these open-plains habitations could we discover any vestiges of stone-work, either in building material or implements. It is very evident that the houses were all of adobe; the mound-like character of the remains justifying that belief.

The "Mesa Verde" extends north and south about twenty, and east and west about forty miles. It is of a grayish-yellow Cretaceous sandstone, with a very nearly horizontal bedding, so that the escarpment is about equal upon all sides, ranging from 600 to 1,000 feet in height. The capping or upper strata are generally firmly and solidly bedded, and retain a perpendicular face of from 200 to 500 feet. It is generally, however, a succession of benches, one above the other, and connected by the steep slopes of the talus. Side-cañons penetrate the *mesa*, and ramify it in every direction, always presenting a perpendicular face, so that it is only at very rare intervals that the top can be reached; but, once up there, we find excellent grazing, good springs, and thick groves of cedar, and the piñon-pine. From the bottom of the cañon up, the slopes of the escarpment were thickly covered with groves of cedar and piñon, gnarled and dwarfed, but sucking up a vigorous livelihood from the cracks and crevices of the barren declivities. Below, the cotton-wood and willow grew luxuriantly beside the streams, while dense growths of a reedy grass towered above our heads as we rode through it. Throughout its entire length, the cañon preserves an average width of about 200 yards, sometimes much wider and again narrower. The stream, meandering from side to side, and frequently interrupted by beaver-dams, cuts a deep channel in the friable earth, which characterizes all the valley-lands of this region. The banks upon either one side or the other are perpendicular, so that it was an extremely troublesome matter to cross. Added to the difficulties of getting in and out of the stream was the thick-matted jungle of undergrowth, tall, reedy grass, willows, and thorny bushes, all interlaced and entwined by tough and wiry grape-vines. The current is sluggish, and the water tinged with a milky translucency, gathered from the soil. The bottom is gravelly, but is covered to a depth of two or three feet with a very soft and miry mud. In every turn were deep pools gouged out, so that the stream seemed to be a succession of them; riffles or bars of sandy gravel intervening, through which the water oozed rather than flowed.

Entering the cañon at its upper end, we strike into the old Indian trail, which comes over from the head of the Rio Dolores, and, passing down this cañon a short distance, turns off to the left and goes over to the head of the San Juan. About a hundred Indians had just passed over it with their horses and goats, so that it was in most excellent traveling order, although winding in and out, and over and among great blocks of sandstone and other *débris* from above; the encroaching stream, too, frequently forced our narrow pathway high up on the slopes of the projecting spurs, the treacherous character of the banks of the stream forbidding the crossing and recrossing usual in such cases. Grouped along in clusters, and singly, were indications of former habitations, very nearly obliterated, and consisting mostly, in the first

four or five miles, of the same mound-like forms noticed above, and accompanied always by the scattered, broken pottery. Among them we found one building of squared and carefully-laid sandstone; one face only exposed, of three or four courses, above the mass of *débris*, which covered everything. This building lay within a few yards of the banks of the stream; was apparently about 10 feet by 8, the usual size, as near as we could determine, of nearly all the separate rooms or houses in the larger blocks, none larger, and many not more than 5 feet square. The stones exposed were each about 7 by 12 inches square and 4 inches thick; those in their original position retaining correct angles, but, when thrown down, were worn away and rounded by attrition to shapeless bowlders. Being so exposed to the elements, the cementing material which bound the masonry together was entirely worn away upon the surface; but, upon pulling away a few courses, it was found binding the rocks together quite firmly. I do not think, however, that it was anything more than an adobe mortar.

As we progressed down the cañon, the same general characteristics held good; the great majority of the ruins consisting of heaps of *débris*, a central mass considerably higher and more massive than the surrounding lines of subdivided squares. Small buildings, not more than 8 feet square, were often found standing alone apparently; no trace of any other being detected in their immediate neighborhood.

We now commenced to note another peculiar feature. Upon our right, the long slopes of protruding strata and *débris* formed promontories, extending out into the cañon. Upon these, and not more than 50 feet above the stream, we found vestiges of former occupation; the foundations in every case being circular, with a deep depression in the center. They generally occured in pairs, two side by side, and ranging from 10 to 20 feet in diameter. No masonry of any kind was visible, but thickly strewn all about any quantity of broken pottery. Above were indications of habitations in the face of the cliff, but not enough to warrant further search.

At those places where the trail ran high up, and near the more precipitous portion of the bluff, we found remnants of stone walls, inclosing spaces of from 5 to 12 feet in length, in the cave-like crevices running along the seams. They were pretty well demolished, the stones undressed and imbedded in mud mortar. In many places, little niches or crevices in rock had been walled up into cupboard-like inclosures of about the size of a bushel-basket. We searched them eagerly, but they had all been despoiled before us. Nothing of any greater importance was found up to the time we made camp at nightfall. All that we had seen during the day was of exceeding interest, but came far short of our expectations.

Our camp for the night was among the stunted piñons and cedars immediately at the foot of the escarpment of the *mesa;* its steep slopes and perpendicular faces rising nearly 1,000 feet above us. Quantities of broken pottery were strewn from above down, across the trail, to the edge of the stream; and, as ruins of some sort generally followed, close attention was paid to the surroundings; but, with the exception of a small square inclosure of rough slabs of stone, set in the earth endwise, and indicating, possibly, a grave, nothing was found to reward our search. Just as the sun was sinking behind the western walls of the cañon, one of the party descried far up the cliff what appeared to be a house, with a square wall, and apertures indicating two stories, but so far up that only the very sharpest eyes could define anything satisfactorily. We had no field-glass with the party, and to this fact is

probably due the reason we had not seen others during the day in this same line; for I doubt not that ruins exist throughout the entire length of the cañon, far above and out of the way of ordinary observation. Cedars and pines also grow thickly along the ledges upon which they are built, hiding completely anything behind them. All that we did find were built of the same materials as the cliffs themselves, with but few, and then only the smallest, apertures toward the cañon; the surface being dressed very smooth, and showing no lines of masonry, it was only upon the very closest inspection that the house could be separated from the cliff.

The discovery of this one, so far above anything heretofore seen, inspired us immediately with the ambition to scale the height and explore it, although night was drawing on fast, and darkness would probably overtake us among the precipices, with a chance of being detained there all night. All hands started up, but only two persevered to the end. The first 500 feet of ascent were over a long, steep slope of *débris*, overgrown with cedar; then came alternate perpendiculars and slopes; in one place a clear exposure of about 25 feet of very fine-looking bituminous coal. Immediately below the house was a nearly perpendicular ascent of 100 feet. That puzzled us for a while, and then we were only able to surmount it by finding cracks and crevices into which fingers and toes could be inserted. From the little ledges occasionally found, and by stepping upon each other's shoulders, and grasping tufts of *yucca*, one would draw himself up to another shelf, and then, by letting down a stick of cedar, a hand, or foot, would assist the other. Soon we reached a slope, smooth and steep, in which there had been cut a series of steps, now weathered away into a series of undulating hummocks, by which it was easy to ascend, and without them, almost an impossibility. Another short, steep slope, and we were under the ledge upon which was our house, (Fig. 12, Plate III.) It was getting quite dark, so we delayed no longer than to assure ourselves that it was all we hoped for, and to prospect a way up when we should return the next morning with the photographic outfit and note-books.

Bright and early, as soon as breakfast was dispatched, we commenced the ascent. Mexico, our little pack-mule, with the apparatus upon her back, by sharp tacks and lively scrambling over the rocks, was able to reach the foot of the precipice of which I have spoken above. Up this we hauled the boxes containing the camera and chemicals by the long ropes taken from the pack-saddle. One man was shoved up ahead, over the worst place, with the rope, and, tying it to a tree, the others easily ascended.

The house stood upon a narrow ledge, which formed the floor, and was overhung by the rocks of the cliff. The depth of this ledge was about 10 feet by about 20 in length, and the vertical space between ledge and overhanging rock some fifteen feet. The house occupied the left-hand half as we face it; the rest being reserved as a sort of esplanade, a small portion of the wall remaining, which cut it off from the narrow ledge running beyond. The edges of the ledge upon which the house stood were rounded off, so that its outside walls had to be built upon an incline of about forty-five degrees; the esplanade, too, had been extended by three abutments, built out flush with the walls of the house, upon the steeply-inclined slope, and giving support probably to a floor and balustrade.

The house itself, perched up in its little crevice like a swallow's nest, consisted of two stories, with a total height of about 12 feet, leaving a space of two or three feet between the top of the walls and the over-

hanging rock. We could not determine satisfactorily whether any other roof had ever existed or whether the walls ran up higher and joined the rock, but we incline to the first supposition. The ground-plan showed a front room about 6 by 9 feet in dimensions, and back of it two smaller ones, the face of the rock forming their back walls. These were each about 5 by 7 feet square. The left hand of the two back rooms projected beyond the front room in an L. The cedar beams, which had divided the house into two floors, were gone, with the exception of a few splintered pieces and ends remaining in the wall, just enough to show what they were made of. We had some little doubt as to whether the back rooms were divided in the same way, nothing remaining to prove the fact, excepting holes in the walls, at the same height as the beams in the other portion. In the lower front room were two apertures, one serving as a door, and opening out upon the esplanade, about 20 by 30 inches in size, the lower sill 24 inches from the floor, and the other a small outlook, about 12 inches square, up near the ceiling, and looking over the whole cañon beneath. In the upper story, a window corresponded in size, shape, and position to the larger one below, both commanding an extended view down the cañon. The upper lintel of this window was of small, straight sticks of cedar, of about the size of one's finger, laid close together, the small stones of the masonry resting upon them. Directly opposite this window was a similar one, as shown in the figure, but opening into a large reservoir, or cistern, the upper walls of which came nearly to the top of the window. It was semicircular, inclosing the angle formed by the wall against the rock, with an approximate capacity of about two and a half hogsheads. From the window, and extending down to the bottom of the reservoir, was a series of cedar pegs, about a foot apart, enabling the occupants to easily reach the bottom. The entire construction of this little human eyrie displayed wonderful perseverance, ingenuity, and some taste. Perpendiculars were well regarded, and the angles carefully squared. The stones of the outer rooms or front were all squared and smoothly faced, but were not laid in regular courses, as they are not uniform in size, ranging from 15 inches in length and 8 in thickness down to very small ones. About the corners and the windows, considerable care and judgment were evident in the overlapping of the joints, so that all was held firmly together. The only sign of weakness was in the bulging outward of the front wall, produced by the giving way or removal of the floor-beams. The back portions were built of rough stone, firmly cemented together. The mortar was compact and hard, a grayish-white, resembling lime mortar, but cracking all over, like some of the adobe mortars. All the interstices between the larger stones were carefully chinked in with small chips of the same material. The partitions were of the same character as the smooth wall outside, both presenting somewhat the appearance of having been rubbed down smooth after they were laid. The apertures, from one room to another, were small, corresponding in size and position to those outside. Most peculiar, however, was the dressing of the walls of the upper and lower front rooms. Both were plastered with a thin layer of some firm cement of about an eighth of an inch in thickness, and colored a deep maroon-red, with a dingy white band 8 inches in breadth, running around floor, sides, and ceiling. In some places, it had peeled away, exposing a smoothly-dressed surface of rock. No signs of ornamentation, other than the band alluded to, were visible. The floor, which was covered to a depth of 2 or 3 inches with dust, dirt, and the excrement of small animals, had

been evened up with a cement resembling that in the walls. The back rooms were half-filled with rocky *débris* from roof and cliff.

While busied with my negatives, the others had prospected the ledge in opposite directions, coming upon ample evidence of its having been quite thickly peopled. Ruins of half a dozen lesser houses were found near by, but all in such exposed situations as to be quite dilapidated. Some had been crushed by the overhanging wall falling upon them, and others had lost their foot-hold and tumbled down the precipice. One little house in particular, at the extremity of this ledge, about fifty rods below the one described above, was especially unique in the daring of its site, filling the mind with amazement at the temerity of the builders and the extremity to which they must have been pushed. Careful views of this having been secured so as to show as well as possible its almost complete inaccessibility, we felt impelled to hurry on to new developments. Apparatus was carefully lowered to the patiently-waiting mule, and adjusted to the pack-saddle, then, mounting our own animals, pushed on down the cañon. Below it opened out into quite a valley, side-cañons opening in from either hand, adding much to the space. Every quarter-mile, at the most, we came upon evidences of former habitations, similar to those already described; the greater majority occurring in the level bottoms and on the low spurs of the escarpment.

Two or three miles below the house in Fig. 12, we discovered a wall standing in the thick brush upon the opposite side of the river. Considerable difficulty was experienced in crossing; in some places having to cut our way through the entangling vines with our belt-knives, and then, when the stream was reached, had to follow it some distance before an opportunity occurred to emerge.

The wall, or walls rather, before us were a portion of an old tower, (see Fig. 1, Plate I,) in the midst of a group of more dimly marked ruins or foundations, extending some twenty rods in each direction from it. As seen in the figure referred to, the tower consisted of two lines of walls, the space between them divided into apartments, and a single circular room in the center. The outside diameter of all was 25 feet, that of the inner circle 12 feet, and as the walls were respectively 18 and 12 inches in thickness, left a space of 4 feet for the small rooms. This outer circle was evidently divided into six equal apartments, but only the divisions marked in the diagram could be distinguished. In the place where they should have occurred, the walls were so broken down and covered with *débris* as to render all details indistinguishable. Where the walls were standing, they showed small window-like doors opening into the inner circle. The highest portion of the inner wall was not more than 8 feet, and of the outer about 15. From the amount of *débris*, I should not judge it to have been much higher—not more than 20 feet at the most. The space between the walls was filled with *débris*. Outside there was very little, except where the wall was totally ruined, and inside the inner circle was more; but, as that had probably been an underground apartment, or excavation, and was still a little below the ordinary level, it was not easy to judge how much had gone into it.

The stones of which this tower was constructed were irregular in size and shape, but with the outer face dressed to a uniform surface, and of the same average size as those already described. The mortar and "chinking" had been worn out entirely from the more exposed portions, giving the wall the appearance of having been dry-laid; but upon pull-

ing away some of the stones to a little depth, they were found to have been well cemented.

Passing on down the cañon, not stopping now to notice the more ordinary forms of ruins, we passed the mouths of numerous side-cañons, down which came great freshets during the rainy season, gouging out deep arroyos, and strewing the surface with the collected *débris* of piñon and cedar, sage-brush and cacti. About the mouth of Coal Cañon, particularly, the whole surface of the "wash" was covered with lumps of fine-looking bituminous coal, as though a thousand coal-carts had traveled that way with their tail-boards out.

We camped at sunset at what our guide called the Rattlesnake Bend, within a half-dozen miles of the outlet of the cañon. We had not discovered any more of the high cliff-houses during the day; but, I doubt not that, if we had had a good field-glass with us, many more might have been found along the crevices near the summit of the escarpment. To have verified our suppositions by a personal inspection would have involved a great deal of labor, and more time than we could have spared from our very scanty store. As it stood, we contented ourselves with securing *types*. In the vicinity of this camp, the cañon changed much in appearance; instead of the long slope of talus capped by a perpendicular ledge, we have here a perpendicular ledge, first of 200 or 300 feet, and then a long receding bench, back to the higher *mesa* beyond.

Close to our camp was one of the little towers that we now came to look upon as common, about 10 feet in diameter, and remaining some 8 feet in height; the inside half-filled with the *débris* from the walls. Half a mile below, in the vertical face of rock, and at a height of from 50 to 100 feet from the trail, were a number of little nest-like habitations. Fig. 5, Plate I, illustrates their general characteristics. The communication with the outside world was from above, to a small window-like door, not shown in the sketch. Two small apertures furnish a lookout over the valley. The walls were as firm and solid as the rocks beneath which they were built. The stones were more regular in size than any noticed, but smaller. The chinking-in of small chips of stone was noticeably neat and perfect on the inside. This was not a commodious dwelling; 15 feet would span its length, and 6 its height, while in depth it was not more than 5 feet. Near by, upon a low ledge, and readily accessible from below, was a string of five or six houses, evidently communicating, mere kennels compared with some others, made by walling up the deep cave-like crevices in the sandstone. The same hands built them that lived in the better houses; the masonry being very similar, especially the inside chinking, which was perfect, and gave the walls a very neat appearance. Fig. 8 of Plate II is an example of the tenacity of their mortar; the view being of one of the line of little houses just spoken of. In this case, a portion of the ledge upon which the house stood has become separated from the cliff, carrying a portion of one of the buildings with it; and although torn away from the remaining wall, and thrown over at a considerable angle, yet it remains perfectly firm and unshaken.

Scratched into the face of the cliff which contained these houses were various inscriptions, one of which I have depicted in Fig. 6 of Plate I. As they are not cut in very deeply, and in some places mere scratches, I doubt very much whether they are contemporaneous with the houses themselves.

Two or three miles farther, and the cañon changed in feature again; the highest level of the *mesa* coming forward and towering over the valley with a thousand feet of altitude; the bottom-lands widening out to a half and three-quarters of a mile in breadth. Cottonwood and

willow fringed the meandering stream in pleasant groves, while the dead level of the valley was heavily carpeted with a dense growth of artemisia and cacti. Everything was dry, dusty, and barren; the stream itself losing in volume, and becoming more turbid. Fig. 13 of Plate III represents in outline the characteristics of the cañon, or valley rather, at this point.

In the high bluff, on the right hand in the sketch, were some of the most curious and unique little habitations yet seen. While jogging along under this bluff, fully 1,000 feet in height, and admiring its bold outlines and brilliant coloring, one of our party, sharper-eyed than the rest, descried, away up near the top, perfect little houses, sandwiched in among the crevices of the horizontal strata of the rock of which the bluff was composed. While busy with my photographs, two of the party started up to scale the height, and inspect this lofty abode. By penetrating a side-cañon some little ways, a more gradual slope was found, that carried them to the summit of the bluff. Now, the trouble was to get *down* to the house, and this was accomplished only by crawling along a ledge of about 20 inches in width, and not tall enough for more than a creeping position. In momentary peril of life, for the least mistake would precipitate him down the whole of this dizzy height, our adventurous seeker after knowledge crept along the ledge until the broader platform was reached, upon which the most perfect of the houses alluded to stood. The ledge ended with the house, which was built out flush with its outer edge. This structure resembled in general features the cliff-houses already spoken of. The masonry was as firm and solid as when first constructed; the inside was finished with exceptional care. In width, it was about 5 feet in front, the side-wall running back in a semicircular sweep, in length 15, and in height 7 feet. The only aperture was both door and windows, and about 20 by 30 inches in diameter. In Fig. 7 of Plate II, I have traced a design of this aerial habitation as it appeared from below; its uniqueness consisting in position on the face of the bluff. To the casual observer, it would not be noticed once in fifty times in passing, so similar to the rocks between which it was plastered did it appear from our position on the trail. A short distance to the right, and one ledge above, was another building of somewhat ruder construction, but with corner square, and walls truncated.

Referring again to Plate III and Fig. 13, the position of these houses, and also of the one in Fig. 12, can be seen in the dark heavy lines near the summit, just above the most precipitous portion of the bluff, generally at a height of from 600 to 800 feet above the level of the cañon. The talus sometimes runs up to within 200 feet of them, very seldom nearer and most frequently lower.

This was the last cliff-house we noticed in this cañon. From the first to the last, all that were upon an elevation, however light, were on the western side of the cañon, with either doors or windows facing east, overlooking the opposite bluffs. We could not find even the faintest vestige of ruins or houses upon the eastern side. Those built low down on the level land did not hold to the same rule, being scattered indiscriminately upon either bank of the stream.

Proceeding down the broad open cañon over the now very easy trail, we espied upon the opposite side of the stream a tower of apparently greater dimensions than the ones noticed above. The crossing was execrable; but, forcing a way through the tangled undergrowth to the stream, a way was found out of it to the ruin some forty rods back; (see Figs. 2 and 3.) The tower only remained; this was circular, 12

feet in diameter, and now about 20 in height, the wall being about 16 inches in thickness. Facing the valley northward was a window-like aperture, about 18 by 24 inches in size; the lower lintel some 7 or 8 feet above the base. The stones of which it was constructed were uniform in size and angle. Being so entirely exposed to atmospheric influences, the mortar had worn away entirely from between the outer layers. Inside, the *débris* was heaped up nearly to the window. By referring to Fig. 3, it will be seen that a rectangular structure, divided into two apartments, each about 15 feet square, joined the tower. Only one corner of three or four courses of masonry remained, shown by the shaded lines; the rest being indicated by mound-like lines of loose *débris*, in which but few stones remained, from which fact, and also that the center of each square was considerably depressed below the surrounding surface, I should judge that it had been an underground structure, its roof not reaching the window midway in the tower. It would be extremely interesting to excavate upon these old foundations; for I doubt not that many interesting relics, and possibly some clew to their manner of life, might be found. Our time, however, was too limited to admit of the experiment, much as we desired the information it might furnish.

In the same neighborhood stood a corner and a portion of a doorway of a house, (see Fig. 4,) showing considerable care and skill in its construction, and, what we had not noticed before, the doorway facing east was a little over 6 feet in height, tall enough to enable a person to stand up in it.

With these, we finished our observations of the ruins in the Cañon de los Mancos. We were now at its mouth, the *mesa* ending as abruptly as it began; the river, turning well westward and following approximately the course of the San Juan, joined it near the southwestern corner of the Territory, at the foot of Ute Mountain.

Striking off to the right from the stream, and following close under the bold escarpment of the *mesa*, we could still discern, as we bore away, group after group of standing walls and mounds, extending down the valley into the broad open plain of the San Juan. It was with many regrets that we turned our backs upon these relics of a forgotten race. Our trail now lay over the peculiar marly earths lying under the sandstones of the table-land, soft, friable, and dusty, without vegetation, our mule's feet sinking into it to the fetlocks at each step. At our right, portions of the *mesa* had become separated, and weathered into peculiar pinnacled turrets. One particularly stood out detached some fifty rods; the trail passing between it and the *mesa*, forming an old and well-known landmark on the old Spanish trail from Santa Fé to Salt Lake. A little farther on, and to the right, was another mass, bearing a curious resemblance to a matron standing with a child beside her, the alternating bands of red and white strata marking off the figure into its different proportions and into flounces and trimmings.

Away to the south and west, over the broad plains of the San Juan, where roamed the great flocks of sheep and goats belonging to the Navajoes, the Callabassas Mountains reared themselves into distinct view, while, between them and the river, a great *cristone* thrust itself up out of the earth to a height of at least 2,000 feet, as veritable a needle as was ever christened such.

Striking into this old trail, we bore around to the western side of the *mesa*, and, near nightfall, arrived at what are known locally as "Aztec Springs." This, for there is one only, lies out upon the northeastern

flanks of the Ute Mountain, and close upon the divide between the waters of the Mancos and the Dolores. It was our intention to have camped here and worked up the surroundings at our leisure; but, very much to the surprise of our guide, the spring was perfectly dry, not even the least moisture remaining to tempt us to dig for it, for others before us had dug to the depth of three or four feet with no reward for their labor. At its best, it could have been but a very insignificant source of supply; the surplus oozing away through a few yards of wiry grass into the dry sand. The basin of the spring lay in quite a depression, that had evidently been excavated for the purpose. A well may have existed; for it cannot be reasonably supposed that the very large settlements which at one time existed in the neighborhood were supplied from it in anywhere near its present condition. The nearest running water was 12 or 13 miles away, and none of the surroundings indicated that this spring ever had any very considerable volume of water. Immediately adjoining the spring, on the right, as we face it from below, is the ruin of a great massive structure of some kind, about 100 feet square in exterior dimensions: a portion only of the wall upon the northern face remaining in its original position. The *débris* of the ruin now forms a great mound of crumbling rock, from 12 to 20 feet in height, overgrown with artimisia, but showing clearly, however, its rectangular structure, adjusted approximately to the four points of the compass. Inside this square was a circle, about 60 feet in diamete, deeply depressed in the center, and walled. The space between the square and the circle appeared, upon a hasty examination, to have been filled in solidly with a sort of rubble-masonry. Cross-walls were noticed in two places; but whether they were to strengthen the walls or had divided apartments could only be conjectured. That portion of the outer wall remaining standing was some 40 feet in length and 15 in height. The stones were dressed to a uniform size and finish. Upon the same level as this ruin, and extending back, I should think, half a mile, were grouped line after line of foundations and mounds, the great mass of which was of stone, but not one remaining upon another. All the subdivisions were plainly marked, so that one might, with a little care, count every room or building in the settlement. Below the above group, some two hundred yards distant, and communicating by indistinct lines of *débris*, was another great wall, inclosing a space of about 200 feet square. Only a small portion was well enough preserved to enable us to judge, with any accuracy, as to its character and dimensions; the greater portion consisting of large ridges flattened down so much as to measure some 30 or more feet across the base, and 5 or 6 feet in height. This better preserved portion was some 50 feet in length, 7 or 8 feet in height, and 20 feet thick, the two exterior surfaces of well-dressed and evenly-laid courses, and the center packed in solidly with rubble-masonry, looking entirely different from those rooms which had been filled with *débris*, though it is difficult to assign any reason for its being so massively constructed. It was only a portion of a system extending half a mile out into the plains, of much less importance, however, and now only indistinguishable mounds. The town built about this spring was nearly a square mile in extent, the larger and more enduring buildings in the center, while all about were scattered and grouped the remnants of smaller structures, comprising the suburbs.

It was sunset by the time we had secured the photographic views necessary to illustrate the leading features of this group. A camp had to be found, a thing very easily done in most localities, but here one very important constituent was wanting: sage-brush and grass abounded,

but water was sadly deficient. However, by good luck, as we might call it, a few pools of the grateful fluid were found in the nearly dry bed of an old stream, about four miles distant from the ruins. This pretense of a stream is known locally as the McElmo, and flows westwardly into the San Juan. For the greater portion of the year, its course is but a deep dry gulch, the water only coming to the surface near its mouth. The valley or cañon through which it flows is peculiar to this region. Starting from the level plain at the foot of the Mesa Verde, it sinks evenly and gradually down between the *mesa*-lands, they having been rent asunder to prepare for this graded way, and, getting deeper and deeper, is finally engulfed in the great chasms debouching into the Colorado. It preserves a very nearly equal width of from two or three hundred yards, perfectly flat and level, from the foot of one escarpment to that of the other, and covered with the all prevalent artemisia and groups of cedar and piñons.

But a short distance above our camp, and upon the top of the *mesa*, which, at this point, was not more than 25 feet above the valley, we found a tower very similar to that on the Mancos (see Fig. 1,) but considerably larger, and surrounded by a much greater settlement. It was about 50 feet in diameter, and, like the Mancos one, double-walled, the space between the two about 6 feet in width, and subdivided into small apartments by cross-walls pierced with communicating doors or windows. Immediately surrounding this tower was a great mass, of which it was the center, of scattered heaps of stone *débris*, arranged in rectangular order, each little square with a depressed center, suggesting large subdivided buildings, similar to the great community-dwellings of the Pueblos and Moquis and the old ruins of the Chaco. Upon the southeast corner of this group, and upon the very edge of the *mesa*, were the remains of another smaller tower, and below it, founded upon the bottom of a small cañon, which ran up at right angles to the McElmo, was a portion of a heavy wall rising to the base of this lesser tower. This group covered a space of about one hundred yards square; while adjoining it on the *mesa* was group after group, upon the same general plan—a great central tower and smaller surrounding buildings. They covered the whole breadth and length of the land; and, turn which way we would, we stumbled over the old mounds and into the cellars, as we might call them, of these truly aborigines. The same painted, glazed, and otherwise ornamented ware, of which I have spoken, accompanied each settlement, and we were contiually picking up new designs and forms.

Starting down the cañon, which gradually deepened as the table-land closed over us, we found upon each hand very old and faint vestiges of this forgotten people, but could give them no more attention than merely noting their existence. Half a dozen miles down, and we came upon several little nest-like dwellings, very similar to those in Figs. 5 and 7, but only about 40 or 50 feet above the valley. Two miles farther, and we came upon the tower shown in Fig. 9, standing upon the summit of a great square block of sandstone, some forty feet in height, detached from the bluff back of it. The building, upon its summit, was square, with apertures like windows upon two faces, looking east and north, and very much ruined, but still standing in some places about 15 feet above the rock on which it was founded. At the base of the rock was a wall running about it, a small portion only remaining, the rest thrown down and covered with *débris* from the house above.

About here we crossed the boundary-line into Utah, and then, two or three miles farther, we came upon a very interesting group. The

valley, at this place, widens out considerably, and in the center stands a solitary butte of dark-red sandstone, upon a perfectly bare and smooth floor of the same, dipping down to the center of the valley at a slight inclination. The butte is but a remnant of a former *mesa*, worn down by time to its present dimensions, some 100 feet in height and 300 in length. It is an irregular mass, seamed and cracked, and gradually going the way its former surroundings have traveled. Running about its base, in irregular lines, are remains of walls, but whether for defense or habitation would be hard now to determine. At the back of the rock, a view of which is had in Fig. 10, are the remains of two quite considerable walls, one above the other; the lower portion—one corner only of a square building, all traces of the remaining portions having entirely disappeared—seemed to serve as a sort of approach to the larger building above, the top of which came up nearly to the summit of the rock. It was about 18 feet in length and 12 in height. Portions only of the side-walls, connecting it with the rock, remained. The stones of which it was built were very uniform in size, angle, and finish, more so than any yet seen, but, like all similarly-exposed buildings, the mortar was washed or worn away entirely from between the outer layers; farther in, it existed as usual. In front was a single aperture of about 18 by 24 inches, whether for door or window would be hard to guess. The only access to the top of the rock was through the window of this house. On top were evidences of some sort of masonwork, that covered it from one end to the other. All the irregular gaps and crevices had been walled up, probably to make an even surface. But few of the stones remained in position; in one or two places, three or four courses—all the rest thrown down and scattered.

In the rear, about fifty yards removed, were other ruins belonging to the same group surrounding the rock. The better-preserved portions consisted of a square tower, with one round corner, about 12 feet in diameter, and upon the lowest side, which stood in a dry run, about 20 feet in height. The walls were 18 inches in thickness, with no signs of apertures. Adjoining this ruin were the ruins of another, but so much thrown down as to be almost unrecognizable; and between these and the rock were circular depressions of some considerable depth, indicating either subterranean apartments or reservoirs. No water could be found anywhere in the neighborhood. The dry bed of the McElmo was fully a mile distant, in which water flows during the winter and spring only.

Aside from the interest attaching to the ruins themselves, there are thrown about this rock and its surroundings the romance and charm of legendary association. The story runs thus, as given us by our guide, and very excellently rendered by Mr. Ingersoll, in his article to the New York Tribune of November 3:

Formerly, the aborigines inhabited all this country we had been over as far west as the headwaters of the San Juan, as far north as the Rio Dolores, west some distance into Utah, and south and southwest throughout Arizona and on down into Mexico. They had lived there from time immemorial—since the earth was a small island, which augmented as its inhabitants multiplied. They cultivated the valley, fashioned whatever utensils and tools they needed very neatly and handsomely out of clay and wood and stone, not knowing any of the useful metals; built their homes and kept their flocks and herds in the fertile river-bottoms, and worshiped the sun. They were an eminently peaceful and prosperous people, living by agriculture rather than by the chase. About a thousand years ago, however, they were visited by savage strangers from the North, whom they treated hospitably. Soon these visits became more frequent and annoying. Then their troublesome neighbors—ancestors of the present Utes—began to forage upon them, and, at last, to massacre them and devastate their farms; so, to save their lives at least, they built houses high upon the cliffs, where they could store food and hide away till the raiders

left. But one summer the invaders did not go back to their mountains as the people expected, but brought their families with them and settled down. So, driven from their homes and lands, starving in their little niches on the high cliffs, they could only steal away during the night, and wander across the cheerless uplands. To one who has traveled these steppes, such a flight seems terrible, and the mind hesitates to picture the suffering of the sad fugitives.

At the *cristone* they halted, and probably found friends, for the rocks and caves are full of the nests of these human wrens and swallows. Here they collected, erected stone fortifications and watch-towers, dug reservoirs in the rocks to hold a supply of water, which in all cases is precarious in this latitude, and once more stood at bay. Their foes came, and for one long month fought and were beaten back, and returned day after day to the attack as merciless and inevitable as the tide. Meanwhile, the families of the defenders were evacuating and moving south, and bravely did their protectors shield them till they were all safely a hundred miles away. The besiegers were beaten back and went away. But the narrative tells us that the hollows of the rocks were filed to the brim with the mingled blood of conquerors and conquered, and red veins of it ran down into the cañon. It was such a victory as they could not afford to gain again, and they were glad when the long fight was over to follow their wives and little ones to the South. There, in the deserts of Arizona, on well-nigh unapproachable isolated bluffs, they built new towns, and their few descendants, the Moquis, live in them to this day, preserving more carefully and purely the history and veneration of their forefathers than their skill or wisdom. It was from one of their old men that this traditional sketch was obtained.

The bare floor of nearly white sandstone, upon which the butte stands is stained in gory streaks and blotches by the action of an iron constituent in another portion of the adjoining bluffs, and this feature probably gave rise to the legend. Half a mile back, or north from this historic butte, is a group of small cave-houses. A long bluff line, about 100 feet in height, of alternating bands of red and white sandstone, has, along a line of its upper strata, quite a number of shallow caves, in which were snug little retreats, securely walled in, the masonry perfect and substantial. Along the top of the bluff were traces of old walls, but well-nigh obliterated.

While passing the mouth of a wide side-cañon, coming in from the right, a tall, black-looking tower caught our eye, perched upon the very brink of the *mesa*, overlooking the valley. Tying our riding-animals at the foot, and leading the pack-mule, with photographic kit, we soon struck into an old trail, worn deep into the rocks, winding and twisting among great bowlders, and overgrown and obstructed with rank growth of sage, cedar, and cacti. In its day, the trail had been a good one; now it was anything but such. Bad as it was, however, it was the only way to the summit, and we were thankful for it. Skirting the edge of the *mesa* a few yards, we came to the tower, the trail passing back of it and on up to a higher level. From above had rolled down a huge block of sandstone, lodging upon the brink, and upon this the tower was built, so that from below both appeared as one. They were of the same diameter, about 10 feet, and some 18 feet in height, equally divided between rock and tower. In construction, it was similar to those already described, of single wall. It was evidently an outpost or watch-tower, guarding the approach to a large settlement upon or beyond the *mesa* lying above it. From this point we now struck out for another group of ruins lying upon a nameless stream, some eight or ten miles farther west. Four or five miles we followed the McElmo down, the trail good, the whole surface covered with a dense growth of artemisia and groves of cedar and piñon, with cottonwoods fringing the dry stream. Branching off at right angles, crossing the heads of two cañons which opened out quickly into great gorges, and then descending into a valley densely covered with greasewood, we came upon the ruins we were in search of. Through the valley ran a deep gulch, a narrow thread of warm, brackish water appearing at intervals in its bed, and gathering into pools in basins a short distance below the ruins.

In Fig. 11 of Plate II, I have sketched a ground-plan of the "city," showing its general arrangement. The stream referred to, and shown in the sketch, sweeps the foot of a rocky sandstone ledge, some 40 or 50 feet in height, upon which is built the highest and better-preserved portion of the settlement. Its semicircular sweep conforms to the ledge; each little house of the outer circle being built close upon its edge. Below the level of these upper houses some 10 or 12 feet, and within the semicircular sweep, were seven distinctly-marked depressions, each separated from the other by rocky *débris*, the lower or first series probably of a small community-house. Upon either flank, and founded upon rocks, were buildings similar in size and in other respects to the large ones on the line above. As paced off, the upper or convex surface measured one hundred yards in length. Each little apartment was small and narrow, averaging 6 feet in width and 8 feet in length, the walls being 18 inches in thickness. The stones of which the entire group was built were dressed to nearly uniform size and laid in mortar. A peculiar feature here was in the round corners, one at least appearing upon nearly every little house. They were turned with considerable care and skill; being two curves, all the corners were solidly bound together and resisted the destroying influences the longest.

With this last our observations of these interesting relics came to an end. Our trip was short and rapid, and instituted in the first place, as I have said, for a quest of the picturesque, and we found it. For a much more complete and faithful exposition of this interesting subject, the reader is referred to the series of views, a catalogue and descriptive list of which will be found appended.

It does not seem worth while for me to advance any theories, or to speculate either upon the age of these ruins or of the ancestry of the builders. The subject is fraught with exceeding great interest, and there is much yet to learn and to discover; for the field of their operations is, as yet, but partially explored. In New Mexico and Arizona, the whole country is covered with somewhat similar remains, that have been described again and again, from the early part of the sixteenth century, when Vaca saw many of them occupied, down to the present day; while over in Utah, upon the great plateau bordering the cañons of the Colorado, are many other groups, spoken of by Powell and Newberry, which resemble more closely these I have described than those to the south. I have not been able to find any published record of the cliff-houses and towers of Colorado, or, for that matter, of any of the others. In 1859, an expedition under Captain Macomb passed both the head and the mouth of the Rio Mancos, and must have seen many ruins similar to the ones I have spoken of. The older forms, out on the open land, were so abundant, that any traveler would notice them; but those hid away in the cañons, I can safely assert, have been seen by very few eyes, indeed, of the present time.

I cannot close without extending thanks to Captain John Moss, of La Plata, our volunteer guide, who accompanied us over the route comprising the ruins. To his accurate knowledge of their locality, and the best way to reach them, as well as of the language of the Indians, is due much of the success of the trip; for it enabled us to make every day count, and no false moves.

DESCRIPTION OF THE ACCOMPANYING PLATES.

PLATE I.

Fig. 1. Ground-plan of round tower in the cañon of the Rio Mancos, consisting of two circular walls, with the intervening space divided into separate apartments. See page 22.

Figs. 2 and 3. Tower adjoining a rectangular foundation in the lower cañon of the Rio Mancos. See page 24.

Fig. 4. A portion of the doorway and one corner of a carefully-built house. Height of doorway 6 feet. Mancos Cañon. See page 25.

Fig. 5. Cliff-house in the rocks of Mancos Cañon at Rattlesnake Bend, 100 feet above the level of the bottom of the cañon. See page 23.

Fig. 6. Inscriptions upon the walls of the cañon near the above. Page 23.

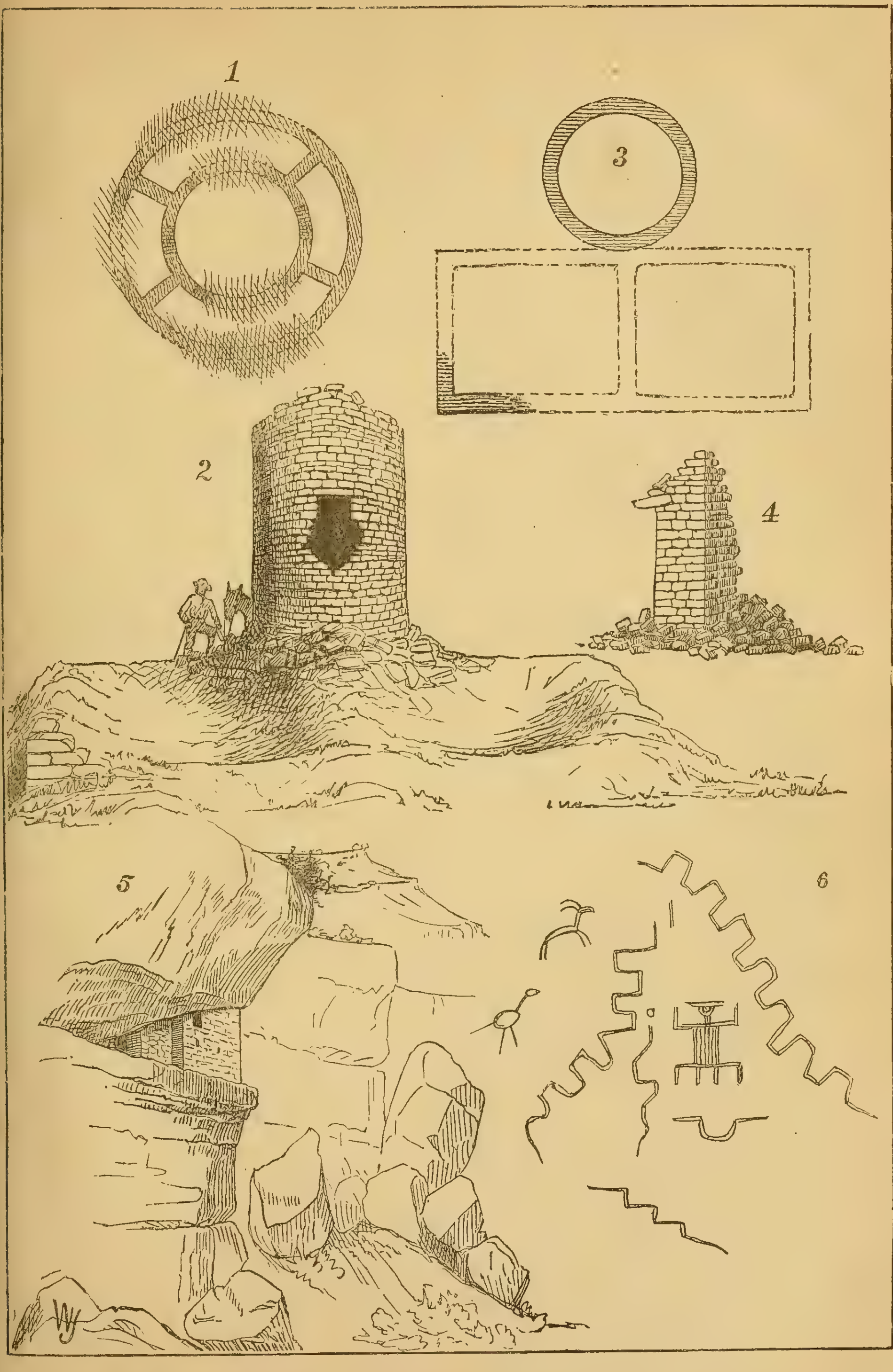
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PLATE II.

Fig. 7. Cliff-house, in the face of a bluff 1,000 feet in height, 800 feet above the ground, near the lower end of the cañon of the Mancos. See page 24.

Fig. 8. Showing the tenacity of the cementing material of these people. Time has rent asunder the rocks upon which this house stood, but each portion still remains firmly attached to its foundation. (Mancos Cañon, page 23.)

Fig. 9. A square tower upon the summit of an isolated rock, in the valley of the McElmo, Utah. Page 27.

Fig. 10. An isolated rock in the valley of the McElmo, covered with ruined houses and walls. A Moquis tradition says that there, in ages past, their ancestors made their last stand against the northern barbarians before retreating to their present villages. See page 28.

Fig. 11. Ground-plan of an extended series of houses, one hundred yards in length, arranged upon a rocky bluff, in the valley of the Hovenweep, Utah. See page 30.

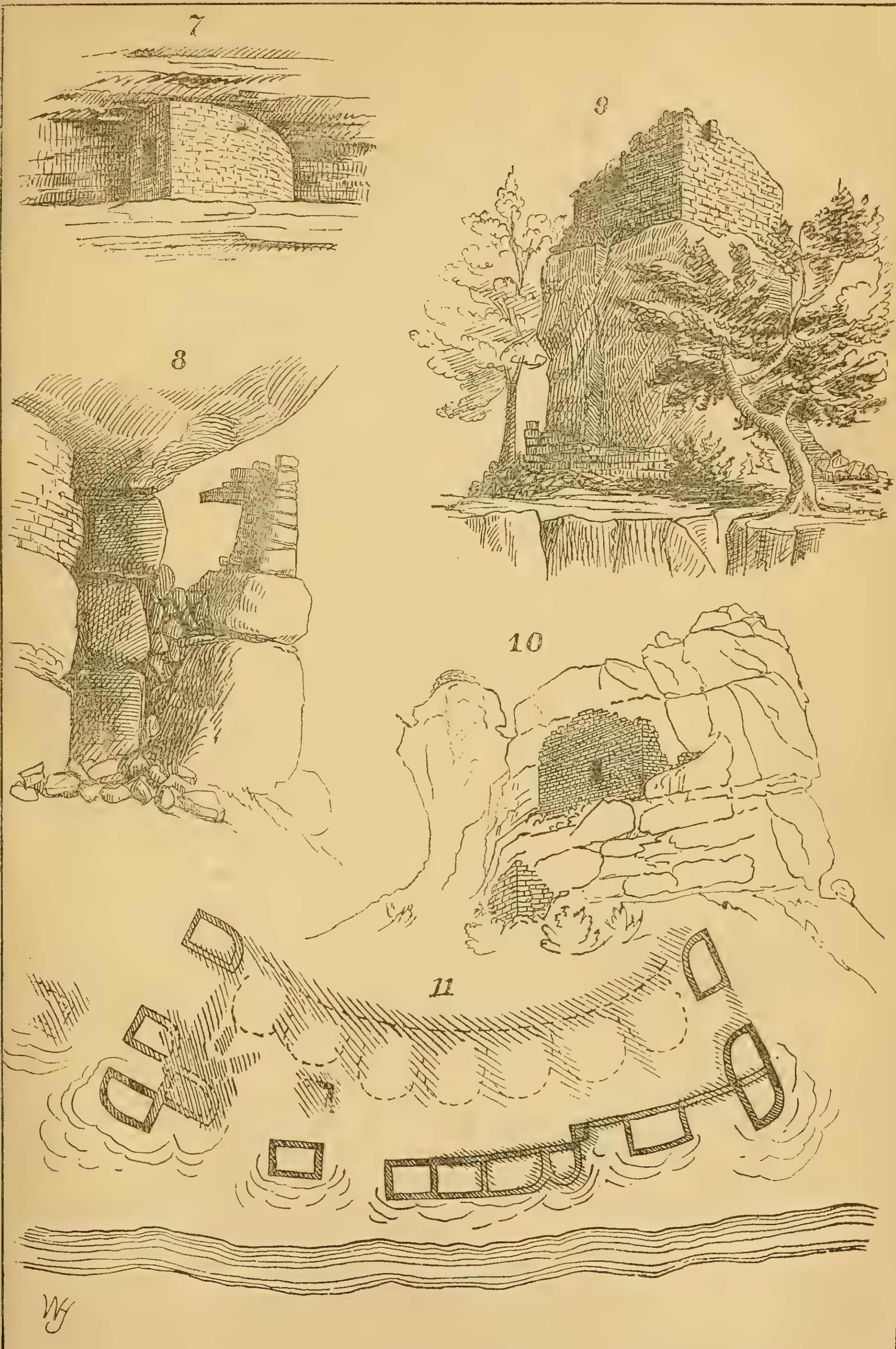
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PLATE III.

Fig. 12. A two-story house in the crevices of the escarpment of the Mancos Cañon, 800 feet vertically above the stream at its base. This house is remarkable, not only upon account of its position, but in having walls of carefully-built and accurately-dressed stone, and the inside surfaces plastered, and painted in two colors, red center with white margin. For description, see page 20.

Fig. 13. A general view of the cañon of the Rio Mancos near its outlet from the Mesa Verde. The table-lands upon either hand vary from 500 to 1,000 feet in height, and it is in the darkly-shaded lines in the upper half of the high bluff on the right that the little houses are found, as shown in Figs. 5, 7, and 12. See page 24.

Fig. 14. A view of the ruined village, in the valley of the Hovenweep, Utah, of which Fig. 11 is a ground-plan. See page 30.

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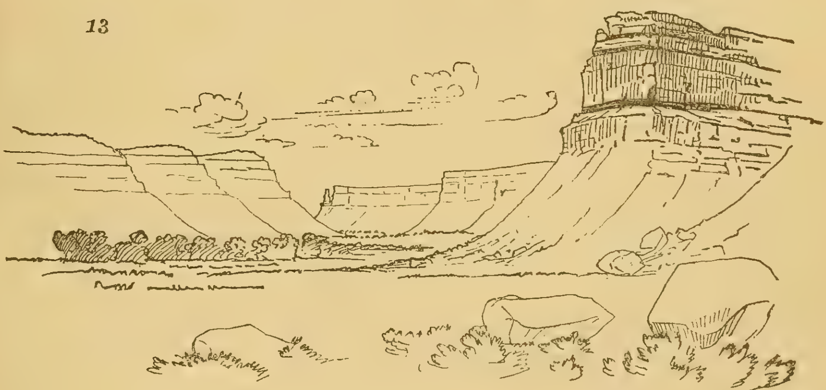

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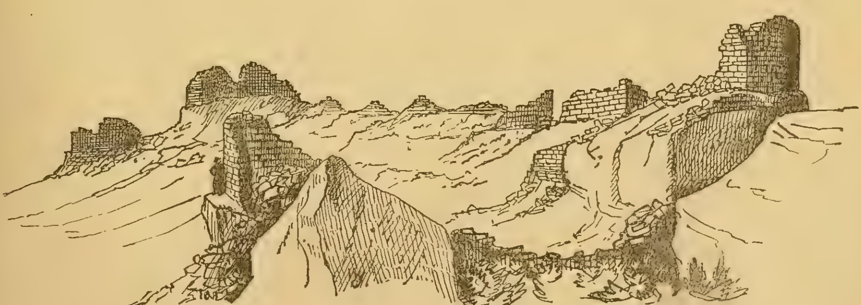

A LIST OF THE PHOTOGRAPHS ILLUSTRATING THE RUINS IN SOUTH-WESTERN COLORADO AND UTAH,

5 × 8.

No. 156. Cliff-house, in the cañon of the Mancos; same as that in Fig. 12. See page 20.
No. 157. Cliff-house, near the above and described on page 22 of the preceding article.
No. 158. A portion of the walls of the round tower in bottom of the cañon of the Mancos. Page 22.
No. 159. A bluff 1,000 feet in height, upon the face of which are small houses, one being shown in Fig. 7. Page 24.
No. 160. Table-lands bordering Mancos Cañon, ranging from 500 to 1,000 feet in height, upon the escarpment of which are the houses of Nos. 156, 157, &c. Page 24.
Nos. 161 and 162. Ruins at Aztec Springs, of walls of great thickness, massive houses and reservoirs, and showing the western face of the Mesa Verde, described on page 26.
No. 163. A ruined tower, surrounded by extensive remains of other buildings, at the head of the McElmo. Ute Mountain in the distance lies across the boundary-line between Colorado and Utah. See page 27.
Nos. 164 and 165. A front and back view of the legendary rock in the valley of the McElmo, Utah, showing the walls built upon its face and the walls surrounding it. See page 28 for description.
Nos. 166 and 167. Cliff-houses, in the face of a low sandstone bluff, half a mile back of the legendary rock.
No. 168. The watch tower, upon the summit of a great rock close to the edge of the *mesa*, overlooking the valley beneath. See page 29.
Nos. 169 and 170. Ruined village in the valley of the Hovenweep, Utah; view from across the little stream, at its outer or bluff face, and—
Nos. 171 and 172. Views, looking inside; the first a general view, and the last close to, and showing more detail, for a description of which see page 30.

STEREOSCOPIC.

Nos. 795 and 796. Two-story cliff-house of the Rio Mancos.
No. 797. Ruined cliff-house, near the above.
No. 798. Ruined tower in the Cañon of the Mancos.
No. 799. Great wall in the Mancos Cañon, upon the face of which are the cliff-houses.
Nos. 800, 801 and 802. Ruined tower at the head of the McElmo.
Nos. 803 and 804. The legendary rock, in the valley of the McElmo, Utah.
No. 805. Ruins in the rear of the legendary rock.
No. 806. Cave-house, valley of the McElmo.
No. 807. Curious weathering of the bluffs near the cave-houses.
No. 808. Watch-tower, valley of the McElmo.
No. 809. Ruins on the Hovenweep, view from the front.
Nos. 810 and 811. Ruins on the Hovenweep, view of the interior,

NOTE ON SOME FOSSILS FROM NEAR THE EASTERN BASE OF THE ROCKY MOUNTAINS, WEST OF GREELEY AND EVANS, COLORADO, AND OTHERS FROM ABOUT TWO HUNDRED MILES FARTHER EASTWARD, WITH DESCRIPTIONS OF A FEW NEW SPECIES.

BY F. B. MEEK, PALÆONTOLOGIST.

The fossils collected during the past summer on Cache La Poudre River, six to ten miles west of Greeley; from five miles below Platteville, on Platte River; from four miles west of Evans, on Thompson River; and at the junction of Little and Big Thompson Rivers, some three or four miles farther westward, are all so obviously from the same horizon, and the localities are so near each other, that they may be all noticed together. In the first place, however, the following list of the species collected at these localities will be given:

1. *Halymenites.*
2. *Avicula* (*Oxytoma*) *Nebrascana*, E. & S.
3. *Nucula cancellata*, M. & H.
4. *Nucula planimarginata*, M. &. H.
5. *Yoldia Evansi*, M. &. H.
6. *Veniella humilis*, M. & H.
7. *Tancredia Americana*, M. & H.*
8. *Sphæriola? obliqua*, sp. n. (See end of this note.)
9. *Cardium speciosum*, M. & H.*
10. *Tellina scitula*, M. & H.
11. *Mactra Warrenana*, M. & H.
12. *Mactra formosa*, M. & H.*
13. *Mactra alta*, M. & H.*
14. *Mactra gracilis*, M. & H., with several other undetermined bivalves.
15. *Dentalium.*
16. *Cylichna scitula*, M. & H.
17. *Lunatia Moreauensis*, M. & H.
18. *Piestocheilus Scarboroughi*, M. & H.
19. *Anchura.*
20. *Ammonites lobatus*, Tuomey.

This group of species, coming, as the specimens evidently did, all from the same horizon, is of some interest, because it gives us the first clew we have had in regard to the exact position in the Cretaceous section of a rock at the mouth of Judith River, on the Upper Missouri, with relation to the other subdivisions of this series there.*

The rock alluded to has not yet been recognized at any other locality in the Upper Missouri country than that mentioned; and as it does not there occur, so far as known, in association with any of the other beds belonging to well-determined horizons of the Cretaceous of that region,

* I do not allude here to the brackish-water beds at that locality, in regard to the exact age of which there have been some doubts, but to a well-defined Cretaceous rock, containing *Baculites*, *Inoceramus*, and other Cretaceous types of fossils.

and the few fossils found in it there seem to be nearly or quite all distinct from those occurring in the several known horizons, we have been at a loss to decide in regard to its exact place in the Cretaceous section. I have long suspected, however, from the affinities of its organic remains, that its position is near the horizon of the top of the Fox Hills group; and although the illustrations of its fossils have been arranged by themselves on separate plates, in the unpublished report on the invertebrate palæontology of the Upper Missouri, I had, some time back, numbered the plates of this work so as to bring those containing the illustrations of the species from this rock, in the ascending series, directly in after those on which the fossils from the Fox Hills group are arranged.

The correctness of this view, in regard to the position of these beds, seems to be sustained by the Colorado collections under consideration. This will be the more clearly understood by reference to the foregoing list of species. This list, it will be seen, contains some seventeen determined species of Cretaceous molluscan remains, four of which (those marked with an asterisk) are certainly identical with forms that have, in the Upper Missouri, only been found in the rock mentioned at the mouth of Judith River; while they are also very characteristic species too of that rock and locality. At the same time, the other thirteen identified species of *Mollusca* mentioned in the list, all occur at numerous Upper Missouri localities in the Fox Hills group; and, with the exception of some three or four of the species that also occur in the Fort Pierre group below, they seem to be all highly characteristic species of the Fox Hills division.

From this blending-together of the Fox Hills species, and those of the marine Cretaceous beds found at the mouth of Judith River on the Upper Missouri, it is evident, I think, that we cannot be far wrong in regarding the latter beds as holding a position at the horizon of the top of the Fox Hills group. Whether they may, however, in the Upper Missouri country, be distinct enough from the Fox Hills group to form a sixth subdivision of the Cretaceous series, holding a position just above the latter, or whether they ought rather to be regarded as merely an upper member of the Fox Hills group, may admit of some doubt in the present state of our knowledge; though I strongly incline to the latter opinion. It is true, however, that they might really be properly distinct, as a subdivision of the Cretaceous, from the Fox Hills group, and still be so intimately related to the latter that some of their characteristic species of fossils might range down into the same at the Colorado localities (just as some of the Fox Hills types also occur in the Fort Pierre group below, at many localities), without necessarily proving that these two subdivisions should not be treated as distinct rocks.

In another point of view, the collections under consideration will doubtless prove to be of some interest—that is, from their bearing on the mooted question respecting the age of the Brown-coal formation along the eastern base of the Rocky Mountains, in Colorado, and at other localities farther westward. Not having myself visited the particular localities at which these fossils were collected, I, of course, cannot speak from personal observation in regard to the stratigraphical relations of these marine Cretaceous beds to the brackish-water coal-bearing strata alluded to; though I am assured by the gentlemen who collected the specimens that, although they came from the very upper beds of well-defined marine Cretaceous, they, nevertheless, in all cases, hold a position below the horizon of all the coal-bearing strata of that region; although, in some instances, they were found not far below the

horizon of thin seams of coal. However this may be, I can assert, in the most positive manner, that the beds from which these fossils came, are clearly, and beyond all question, of Cretaceous age. This is not only shown by the presence, among the fossils found in them, of the well-known and widely-distributed Cretaceous genus and species *Ammonites lobatus*, Tuomey,* but even more clearly by the fact that *all* of the other identified species of bivalves and univalves are certainly identical with species widely distributed in the Upper Missouri country in beds containing numerous examples of *Ammonites*, *Scaphites*, *Baculites*, *Inoceramus*, and other decided Cretaceous types.

At the same time that all of the identified molluscan remains from these beds are such decided Cretaceous types, it will be observed that a number of specimens, which I am entirely unable to distinguish from a fucoid referred, by Professor Lesquereux, to the genus *Halymenites*, and widely distributed in the Brown-coal deposits of the far-west, also occur here directly associated with these Cretaceous shells. This fucoid has been considered a Tertiary type by my able and distinguished friend, Professor Lesquereux, and relied upon as at least one of the evidences that these Brown-coal deposits belong to the Tertiary epoch, and not to the Cretaceous. It seems to me evident, however, from the occurrence of this fossil here, along with numerous decidedly Cretaceous shells, as well as at Coalville in Utah, where I found it at least 1,000 feet below the horizon of well-marked Cretaceous strata, that *it*, at least, can no longer be regarded as an exclusively Tertiary type.

I should not omit to state here, however, that Mr. Holmes, who collected most of the fossils under consideration, informed me that he did not find, in the beds from which they were obtained, any of the dicotyledonous leaves so numerous in the coal-strata very widely distributed in Wyoming, Colorado, and other parts of the far-west. This is also precisely the case at Coalville, Utah, where I found this fucoid ranging far down below well-defined Cretaceous strata; while a two-weeks' careful search there by Doctor Bannister and myself failed to discover any of these dicotyledonous leaves so common, along with this same fucoid, at Black Butte, and other localities in Wyoming, as well as in Colorado.

It should also be noticed that not a single species of these animal remains (which are very abundant in individuals at the Colorado localities under consideration) can be identified with any of the forms yet known from the coal-bearing strata of that region, or from Wyoming and other localities farther westward.

The specimens from farther eastward were taken from a shaft sunk on the Kansas Pacific Railroad, at a locality about two hundred miles east of Denver, Col. I have seen no section of the strata penetrated by this shaft, but have been informed that it was sunk to a depth of 1,200 feet, and that it passed through many beds of sandstone and some shale and brown coal. The specimens submitted to me were found at two different horizons: one about 400 feet below the surface; and the other at a depth of about 45 feet. Whether or not any of the other beds struck contained fossils, I have not been informed. Those from the lower horizon are contained in a rather firm, dark shale, said to overlie

* I am now almost entirely satisfied that this species is identical with an Upper-chalk form of Limbourg, that has been identified by Binkhorst with *Ammonites Pedernalis*, von Buch. (See Mong. Gast. et des Cephalop. de la Craie sup. du Duche de Limbourg, 21, pl. V^{a1}, figs. 6 *a*, *b*, &c.). I have not at hand von Buch's figures and description of his species, but the shell figured by Binkhorst is apparently not distinct from that before me; though I doubt its identity with the Texas shell figured by Roemer under von Buch's name.

a three-foot bed of coal. In the specimens of this shale, I was somewhat surprised to find two of the same Cyrenoid shells that occur in an exactly similar shale over one of the coal-beds at Hallville, on the Union Pacific Railroad, in Wyoming, five hundred miles farther westward, and at about 2,800 feet greater elevation above tide. The specimens of shale from these two localities are exactly alike in all respects, and the fossils contained in them are not only beyond question the same species, but so precisely similar in their state of preservation that it would be quite impossible to distinguish in any way the collections from the two localities.

The specimens from the other horizon, 45 feet below the surface, in this shaft, consist of a conglomeration of shells, with merely enough gray clay, and some sand, to fill the interstices. The shells, so far as seen, are all bivalves, generally in so tender a condition that it is very difficult to separate any of them from the matrix in a good state of preservation, though they were evidently, in most cases at least, not broken or water-worn before being buried in the mud and sand forming the stratum in which they are found. They consist, so far as determined, of an *Anomia*, and perhaps two or three species of Cyrenoid shells, with a few fragments of other undetermined bivalves. The *Anomia* I believe to be identical with a species found at Black Butte station, Wyoming, on the Union Pacific Railroad, only about two miles east of Hallville coal-mines, and perhaps 600 to 800 feet higher in the same series. The Cyrenoid shells are also closely allied to, and possibly in some cases identical with, forms found at Black Butte station.

A single fragment of a bivalve, found among the specimens, consisting of most of the hinge of a right valve, certainly belongs either to the genus *Cyprina* or *Veniella* (= *Venilia*, Morton). The hinges of these two types are so similar in some of the species that it is not always easy to distinguish the two without pretty good specimens, or at least such as give a moderately clear idea of the form and general external appearances of the shell. The specimen mentioned does not show the posterior lateral tooth; but its cardinal and anterior lateral teeth are *very similar* to those of *Veniella*. The scar of its pedal muscle, however, *seems* to be very nearly, if not quite, connected with that of the anterior adductor, as in *Cyprina*. I regret very much that I could not find an entire valve of this shell among the specimens, so as to be able to decide the question in regard to which of these two genera this shell really belongs; because, if it is a *Veniella*, it would furnish a strong argument in favor of the conclusion that this whole formation belongs to the Cretaceous period, and not to the Tertiary; if a *Cyprina*, however, it would prove nothing either way, that genus being common to both Cretaceous and Tertiary rocks, as well as to our existing seas.

That the formation from which these fossils came, however, is the same as the Bitter Creek series of Wyoming, including the Black Butte beds, the Hallville coal-mines, Point of Rocks, and Rock Spring coal-mines, &c., I have scarcely a shadow of doubt; and the determination of this fact is one of considerable interest in several points of view. In the first place, it shows that the Bitter Creek series, that contains such valuable deposits of an excellent quality of brown coal, extends far out under the plains east of the Rocky Mountains, and at least holds out a reasonable prospect that valuable deposits of this useful substance may be found by sinking shafts in these treeless plains (if the discovery has not already been made*), where a good supply of fuel is of such great

*I do not know whether workable beds of coal were found in the shaft already sunk or not.

importance to the present and future inhabitants of the country. Again, as these deposits, now occupying such different elevations in Wyoming and Colorado, are evidently of brackish-water or estuary origin, and consequently were originally formed at the same level (that of the sea), their present different elevations give us some idea of the great changes in the physical features of this internal region of the continent that have taken place in comparatively modern geological times.

A species of bivalve, that I have described on one of the following pages under the name *Cyrena? Holmesi*, came from four miles north of Golden City, Col., at the eastern base of the Rocky Mountains. According to Mr. Holmes's observations, the bed in which this fossil occurs holds a position about 500 feet above the horizon of the coal-beds mined near there. The specimens of this shell brought in, although showing, in some cases, the form and ornamentation of the species well enough, unfortunately in no instance give any satisfactory information in regard to its generic relations; and, as the species is new and distinct from all of those we have yet had from the well-determined horizons of this region, it gives little or no information in regard to the age of the rock in which it was found, though it is most probably Tertiary.

ANOMIA MICRONEMA, Meek.

Shell of medium size, thin, orbicular, subovate, or somewhat irregular; upper valve moderately convex, or more or less depressed, even nearly to flatness in some cases; beak very small, depressed, and nearly, but not quite, marginal; cardinal margin generally a little truncated and slightly thickened; surface ornamented by very fine, regular, often deflected, radiating stria, and small, sometimes regularly-disposed, concentric marks of growth. (Under valve unknown.)

Diameter of well-developed specimens generally about 1 inch.

This species is quite abundant, and generally moderately well preserved at the locality. As usual with fossil species of the genus, only upper valves were found. These show the muscular impressions to be exactly as in true *Anomia*.

Locality and position.—From a shaft sunk on the Kansas Pacific Railroad, two hundred miles east of Denver, Col., 45 feet below the surface, from beds of the age of the Wyoming Bitter Creek coal-series.

CORBICULA? (LEPTESTHES) PLANUMBONA, Meek.

Shell attaining a moderately large size, rather thick and strong, especially about the hinge of large specimens, generally of a short transversely-oval or subelliptic form, but rather variable in outline, moderately and evenly gibbous, the greatest convexity being in the central region; anterior margin prominently and rather narrowly rounded; posterior vertically subtruncated; base forming a more or less nearly semi-elliptic or semi-ovate curve; dorsal outline sloping from the beaks, the anterior slope being more abrupt and concave in outline, while the posterior is generally convex; umbones subcentral, moderately prominent or somewhat depressed, usually eroded, and more or less flattened near the apices, which are not strongly incurved, distinctly pointed, or raised much above the hinge-margin; lunular region, in the specimens, with more gibbous umbones, somewhat excavated, but not distinctly impressed, or with defined margins; ligament narrow and not very prominent; anterior muscular impression ovate, well defined, and distinct from the small pedal scar under the hinge, above and behind its

upper end; posterior muscular impression broader and more shallow; pallial line usually well defined, and provided with a shallow, rounded, or semicircular sinus; hinge rather strong, with the three cardinal teeth well developed in each valve, the anterior two of the left valve, and the posterior two of the right, being more or less sulcated; anterior lateral teeth long, linear, and not very prominent; posterior shorter and very remote from the cardinals; both anterior and posterior laterals very nearly smooth, or minutely granulo-striate.

Length of a medium-sized adult specimen, 1.62 inches; height, 1.28 inches; convexity, 0.92 inch. Some fragments indicate about one-third greater size for the largest.

Along with the specimens in which the foregoing characters were observed, there are a few others of smaller size, that are proportionally shorter and more nearly trigonal in outline, the beaks being also more elevated, central, and not at all flattened or eroded. These probably belong to a distinct species; but as the typical specimens of the species just described vary considerably in form, and all are in a very unsatisfactory condition of preservation, I have some doubts in regard to the propriety of separating the shorter form as a distinct species. Should additional collections, in a better state of preservation, show this form to be distinct, however, it might be called *C.* (*Leptesthes*) *umbonella*. I suspect that there are still one or two other species represented among the numerous broken and distorted specimens in the collection, but the material is not sufficient to settle this question.

The species here described seems to be most nearly allied to some of the shorter of the forms described by me in Dr. Hayden's Sixth Annual Report, page 512, doubtfully as a variety of *C. fracta*, under the name *C.? fracta*, var. *crassiuscula*, but which are probably distinct from *C. fracta*. At any rate, the species here described is a still shorter, more nearly equilateral, and generally more gibbous shell, which also usually differs in the peculiar flattening of its umbones. All of these shells, however, as well as the typical *C. fracta*, agree closely in their hinge-characters, and form a very peculiar group.

In first proposing the subgeneric name *Leptesthes* for the reception of *C. fracta* and the supposed variety *crassiuscula*, from the Bitter Creek beds at Hallville and Black Butte, Wyo., I called attention to the fact that these shells seem to combine the characters of both *Cyrena* and *Corbicula*. In the elongation and striation of their lateral teeth, particularly the anterior laterals, they agree most nearly with *Corbicula*; but in the much more transverse form of the shell in most cases, as well as in size and general appearance, they agree better with the Cyrenas, particularly with such species as *Cyrena Floridana*, Conrad; *C. colorata*, Prime; and *C. salmacida*, Morelet, than with at least the existing forms of *Corbicula*. The name *Leptesthes* was suggested by the extreme thinness of the typical species *C. fracta*; but we now know that this character is not constant in the group, the other species being generally quite thick. Nor is the very transvere form of the typical species, and the species or variety *C. crassiuscula*, a constant character, some of the others now before me from Colorado being as short as several existing species of *Corbicula*. These shells, however, present certain peculiar hinge-characters that seem to be constant. These are the narrow, elongated form of the antero-lateral teeth, like those of *Corbicula*, and, at the same time, the rather narrow but *shorter* form, and remote position of the posterior laterals, more like those of *Cyrena*, excepting that they are separated from the cardinal teeth by a more or less broad-flat space in each valve, fitting closely together when the valves are united. In the striation of the

lateral teeth, these shells correspond more nearly to *Corbicula;* but the striæ are very much less distinct than we usually see in the latter, and often very nearly obsolete (quite so in slightly-worn specimens), while they are mainly broken up into little granulations.

I also observe that, in all of our species of this type, the little pedal muscular scar is detached from the anterior adductor. Having no specimens of *Corbicula* at hand (here in Florida, where I am writing) for examination, and nothing being said on this point in any of the descriptions of that genus within reach, I do not know whether or not our shells agree in this character with the existing species of *Corbicula.* They certainly differ, however, decidedly in this respect from two of the existing Florida species of *Cyrena*, now before me, in which the pedal scar of each valve is distinctly connected with the anterior adductor.

On the whole, although still regarding these fossil shells as being perhaps more nearly allied to *Corbicula* than to *Cyrena*, I am now more than ever impressed with their intermediate combination of characters, and think that they might, with almost equal propriety, be ranged as a subgenus under *Cyrena;* if so, of course the name of the species here described would become *Cyrena* (*Leptesthes*) *planumbona.*

Locality and position.—Two hundred miles east of Denver City, on the Kansas Pacific Railroad, where they were found in a shaft at a depth of 40 feet below the surface.

CYRENA? HOLMESI, Meek.

Shell under medium size, thin, transversely ovate or subtrigonal, rather compressed; anterior side shorter than the other, and rounded in outline; posterior moderately produced and subtruncated at the extremity; basal margin transversely semi-ovate, its most prominent part being antero-centrally; beaks somewhat depressed, and placed about half-way between the middle and the anterior; dorsal margins forming a rather long, nearly straight, or slightly convex, gentle slope behind the beaks, and declining more abruptly in front, with a distinctly sinuous outline just before the beaks; surface ornamented by numerous fine, regular, sharply-defined, concentric lines.

Length, 0.62 inch; height, 0.54 inch; convexity, about 0.32 inch.

There are among the specimens, apparently of this species, quite a variety of forms, produced, as I am inclined to believe, mainly at least, by accidental distortion, though they may represent several distinct species. The specimen from which the foregoing description and measurements were derived presents the appearance of not having been distorted, and, as may be seen by the measurements, is decidedly longer than high. Others, however, agreeing exactly in surface-markings and most other characters, have the length and height nearly equal, or the latter even a little greater than the former. Some of the specimens also differ from that taken as the type of the species, in having the posterior umbonal slopes prominent and subangular all the way from the beaks to the posterior basal extremity, instead of only moderately convex. As above intimated, however, all of the specimens departing decidedly from the typical form show more or less indications of accidental distortion, and present precisely the same surface-markings as the typical specimen.

In regard to the generic relations of these shells, the specimens are far from satisfactory, none of them showing the muscular or pallial impression, or the cardinal teeth. Some of the casts, however, show that there was a posterior lateral tooth in one or both valves, rather elongated

parallel to the posterior dorsal margin, and a much shorter anterior lateral close to the beak. Of course, it will be impossible to determine the generic characters of these shells until more satisfactory specimens can be obtained, and it is only provisionally that the species is now referred to the genus *Cyrena*.

I have had this species under consideration for some years, hoping that better specimens would be found; but, as a second visit to the locality has failed to bring to light any more satisfactory material, and the geologists of the survey desire to have a name by which they can refer to the shell, I have concluded to describe it doubtfully under the genus *Cyrena*. The specific name is given in honor of Mr. William H. Holmes, the artist of the survey, who discovered the type-specimens.

Locality and position.—On Ralston Creek, three to four miles north of Golden City, Col., from beds supposed to hold a position from 400 to 500 feet above the beds of coal mined at Golden City. Probably of Tertiary age. I th'nk Dr. Pale found the same species farther south, between Golden and Colorado Springs, not far from the latter. No other fossils were found associated with it

SPHÆRIOLA ? OBLIQUA, Meek.

Shell (as determined from an internal cast) obliquely oval-subcordate, very gibbous, the greatest convexity being in the central region of the valves; posterior side very short, and rounding somewhat obliquely downward and forward into the base, which forms a transversely-semi-ovate or semi-elliptic curve; anterior side longer and more or less regularly rounded; hinge very short; beaks prominent, gibbous, and moderately incurved, but not directed very obliquely forward, situated at the anterior end of the hinge, nearly over the middle of the valves; muscular impressions faintly marked, the posterior being placed close up under the end of the hinge; pallial line obscure, but apparently simple. (Surface-markings and hinge unknown.)

Length, 1.95 inches; height, 1.94 inches; convexity, 1.57 inches.

I merely place this species provisionally in the genus *Sphæriola*, as I have done with two similar Upper Missouri Cretaceous forms; nothing being yet known in regard to the hinges of these shells beyond the fact that they have no lateral teeth. It is quite as probable, and perhaps even more so, that when their hinge-characters can be determined, these species will all be found to present generic differences from *Sphæriola*.

The species here under consideration seems to agree most nearly with the Upper Missouri form that we have called *S.? cordata*, but it has less elevated and less pointed beaks, and differs materially in its much more oblique form; its anterior basal margin being so much more prominent than the posterior as to give a decided backward obliquity to the umbones, excepting their points, which are turned a little forward.

Locality and position.—From the highest Cretaceous beds on Left-hand Creek, half-way between Long Mont and Boulder City, Col.

RHYNCHONELLA ENDLICHI, Meek.

Shell attaining a rather large size, subtrigonal, with breadth nearly or quite equaling the length, the widest part being in advance of the middle, becoming very convex with age anteriorly; posterior lateral margins straight, or but slightly convex in outline, laterally compressed or flattened, and diverging from the beaks, in adult specimens, usually at about right angles or less; anterior lateral margins rounding to the

front, which is generally more or less produced, and, as seen in a direct view from above or below, transversely truncated or a little sinuous at the middle. Dorsal valve very convex, particularly along the middle, the elevation increasing rapidly to the front, which is raised so as to form a very prominent, broad, rounded, or somewhat flattened, and slightly-defined mesial fold, rarely traceable back to the central region, while, on each side, the lateral slopes descend abruptly to connect with those of the other valve; beak moderately prominent, and incurved more or less nearly at right angles to general plane of the valves; interior with a prominent mesial septum extending forward nearly half-way to the front. Ventral valve flattened at the umbo, and so broadly and profoundly sinuous from near the same anteriorly as to leave only a prominent angular margin on each side, the sinus being broadly flattened along the middle, and increasing rapidly in depth to the front margin, which is curved upward more or less nearly at right angles to the plane of the valves, and produced in the middle, in the form of a large extension fitting into a corresponding sinuosity in the middle of the front of the other valve; anterior lateral margins on each side of the sinus meeting those of the other valve at acute angles; posterior lateral margins very abruptly deflected and rectangularly deflected along each side of the sinus, to meet those of the other valve; beak comparatively small. Surface of both valves ornamented by numerous radiating costæ, which, on the umbones, are merely distinct raised lines, but increase in size anteriorly, particularly those in the sinus and on the mesial fold, where, toward the front of adult specimens, they become moderate-sized, rounded ribs, of which four to six or seven may be counted in the immediate flattened bottom of the sinus, and two or three more on the fold, while those on the lateral slopes bifurcate, and continue, of smaller size, to the anterior and antero-lateral margins. (Finer surface-markings unknown.)

Length of an adult specimen, 1.78 inches; breadth, 1.53 inches; convexity, about 1.24 inches.

This is a fine species, more nearly resembling some Devonian and Upper Silurian forms than the usual Carboniferous types. Its most marked features are the large size of its mesial sinus, the flattening of its posterior lateral slopes, and the angularity of the posterior lateral margins of its ventral valve on each side of the sinus, formed by the abrupt flexure of those margins to meet those of the other valve. This inflection of the posterior lateral margins gives this part of the shell a peculiar truncated, rectangular appearance, contrasting strongly with the very acute angles formed by the connection of the antero-lateral margins of the valves.

The specific name is given in honor of Dr. Endlich, of the United States geological survey of the Territories.

Locality and position.—East of Animas River, Colorado Territory, where it occurs associated with a small *Productus* of the type of *P. subaculeatus*. According to Dr. Endlich's sections, as well as from its affinities, it would seem to be most probably an Upper Devonian species. Fragments of it have been brought in from other localities in the Rocky Mountains.

DEPARTMENT OF THE INTERIOR.

BULLETIN

OF

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OF

THE TERRITORIES.

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DEPARTMENT OF THE INTERIOR.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

I.—MONOGRAPH OF THE GENUS LEUCOSTICTE, SWAINSON; OR, GRAY-CROWNED PURPLE FINCHES.

BY ROBERT RIDGWAY.

II.—THE CRANIAL AND DENTAL CHARACTERS OF GEOMYDÆ.

BY DR. ELLIOTT COUES.

III.—RELATIONS OF INSECTIVOROUS MAMMALS.

BY THEODORE GILL.

IV.—REPORT ON THE NATURAL HISTORY OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, 1874.

BY ERNEST INGERSOLL.

BULLETIN, NO. 2.—SECOND SERIES.

NOTE BY THE GEOLOGIST-IN-CHARGE.—In publishing a second series of the Bulletin, the pages will be numbered consecutively until a volume is completed, so that individuals or societies retaining the numbers as they are issued may bind them together. An effort will be made to number the plates and figures in the same way. The final number will contain an index to the whole.

A MONOGRAPH OF THE GENUS LEUCOSTICTE, SWAINSON; OR, GRAY-CROWNED PURPLE FINCHES.

By Robert Ridgway.

INTRODUCTION.

The genus *Leucosticte* is composed of sparrow-like birds, characterized by terrestrial habits, rosy tints to the plumage of the posterior portions of the body, and a fondness for the cold climate of high latitudes or alpine elevations. Its distribution within the United States is exclusively western; none of the species occurring eastward of the base of the Rocky Mountains, while one of them occurs, in winter, thence to the Pacific coast. The Rocky Mountain region is their center of abundance; for, of the three species known in North America, two occur only there; the third mingles with these during its migrations, but is a species of very wide distribution.

It happened that, in the course of his western explorations, Dr. Hayden frequently met with these birds, being the first to secure a considerable number of specimens of the then only known, and very rare, species; while to him is also due the honor of making the discovery of one entirely new to science.

HISTORY.

The first species of this genus was described in 1831 by Swainson and Richardson in their "*Fauna Boreali-Americana*" (vol. 2, pp. 265–266), from "a specimen killed on the Saskatchewan, May, 1827." It was named "*Linaria* (*Leucosticte*) *tephrocotis* Swains.—Gray-crowned Linnet," and tolerably well figured in plate 50, facing page 365. This figure represents the summer-plumage, with black bill. Swainson's second notice of the species (Birds, II, 1837), Audubon's figures and descriptions in his several works, and Bonaparte's diagnoses in "*Conspectus Generum Avium*," etc., were all based upon the same specimen, which, for nearly a quarter of a century, remained the unique representative of the genus. It was not until the year 1850 that the second specimen of *L. tephrocotis* was secured; the fortunate finder being Captain Stansbury, who, on March 21, 1850, obtained a fine specimen at Salt Lake City, Utah (see "Stansbury's Salt Lake," Appendix C, by S. F. Baird, p. 317). This may have been the first specimen obtained in the United States; but in the National Collection are two very imperfect examples, accredited to Colonel Frémont, but without dates on the labels, on which are recorded as additional data merely the locality, "Rocky Mountains." One of these specimens is var. *tephrocotis*, and the other var. *littoralis*.

In the mean time, at about the same date as that when Swainson's specimen was described, a second form (*L. tephrocotis* var. *griseinucha*) was discovered in Russian America, and described by Pallas, in "*Zoögraphia Rosso-Asiatica*" (II, 1831, p. 23), as *Passer arctoa* var. γ. It first received its distinctive name in 1841, when Dr. J. F. Brandt named it *Fringilla*

(*Linaria*) *griseinucha* in the Bulletin of the Academy of St. Petersburg (November, 1841, p. 36). In the same work (p. 22), two other forms, supposed to be "varieties" of "*Passer*" *arctoa*, were described, as follows:—(1) "*β*. 1. Ex insula Curilis: . . . . . . cervice cano-albida, dorso fusco grysoque nebuloso; subtus nigra . . . . . . ventris et uropygii cinnabarinus" etc., and (2) "*β*. 2. itidem Curilica: Capite supra (præter frontere fuscam) cum cervice ferruginea, dorso fusco . . . . . . subtus fusca, roseo . . . . . . crissum totum roseum; uropygii plumæ et tectricibus caudæ apice rosæ", etc. These descriptions correspond well with the characters of *L. atrata* and *L. australis*, respectively, and may possibly be from specimens of those species, though the remoteness of the locality renders the question extremely doubtful.

In 1841, a third form (*L. brunneinucha*) was discovered in Kamtschatka, and described by Dr. Brandt in the paper above cited (p. 35). Two years later, *L. griseinucha*, Brandt, was redescribed by Mr. Gould as *L. griseogenys* in the Proceedings of the London Zoölogical Society (1843, p. 104), in a paper entitled "On Nine New Birds, collected during the voyage of H. M. S. Sulphur."

The species of the genus *Leucosticte* as restricted* stood thus until the year 1869, when the smaller southern form allied to *griseinucha* was described as *L. littoralis* by Professor Baird, in the Transactions of the Chicago Academy of Sciences (I, ii, 1869, p. 317, pl. 28, fig. 1); the type being from Sitka, Alaska. The year following, a form intermediate between *littoralis*, Baird, and *tephrocotis*, Swains., was described by Professor Baird in one of the Reports of the Geological Survey of California (Ornithology, I, 1870, 163) as *L. campestris*, Baird, based on a specimen obtained at Denver, Colorado, by Dr. Wernigk. This bird now proves to be only one of a transitional series connecting *tephrocotis* and *littoralis*.

The next species of the genus which came to light was discovered in July, 1871, by Mr. J. A. Allen, of the Museum of Comparative Zoölogy of Cambridge, who found a singular form breeding upon the alpine summits of Mount Lincoln, Colorado, at an elevation of over 12,000 feet above the sea. This fact was published by the discoverer in the American Naturalist for June, 1872 (p. 350), and subsequently in the Bulletin of the Museum of Comparative Zoölogy (III, No. 6, July, 1872, pp. 162–163). The birds obtained by Mr. Allen were called by him *L. tephrocotis*; but attention was called to the fact that they had no ash on the head, as in typical specimens of that species. Mr. Allen's remarks conclude with the suggestion that these specimens "represent the smaller, brighter-colored, southern race, in which the ash on the head has entirely disappeared." Still, no name was proposed for the race. Upon request, these specimens were kindly submitted to the authors of the "History of North American Birds," who, after due comparison, decided that they, in all probability, represented the summer, or breeding, plumage of ordinary *L. tephrocotis*, of which only winter-examples had been seen; they were accordingly described as such in that work (vol. I, pp. 504–505, footnote). Shortly after this decision, however, a very large collection of var. *griseinucha* in its breeding-plumage was received at the National Museum from the Aleutian Islands, where they were collected by the well-known artist Mr. Henry W. Elliott; and, while these had the jet-black bill and heightened crimson, characteristic of the breeding-season, *the ash of the head remained the same!* This fact at once prompted a new examination of the Mount Lincoln series, after which it was decided that they did not represent merely the breeding-plumage of var. *tephrocotis*, but that

* We exclude from the genus *L. arctoa*, *L. giglioli*, and their allies, (See p. 67.)

they were a distinct form, and probably the southern race, as suggested by Mr. Allen. They then were made the types of *L. tephrocotis* var. *australis*, Allen; the manuscript-name on the labels being first published in November, 1873, by the writer, in the Bulletin of the Essex Institute (vol. V, pp. 189–190). Large series of specimens received at later dates establish the fact of the specific distinctness of this bird from *L. tephrocotis*, and point to its nearer relationship with the Kamtschatkan L. *brunneinucha*.

On the 20th of September, 1870, Dr. F. V. Hayden, the well-known explorer, obtained on the Uintah Mountains, in Utah, a specimen, which was described, in the "History of North American Birds," as the young of *L. tephrocotis*—with the remark that "were it not unmistakably a bird of the year, it would be considered almost a distinct species, so different is it from adult specimens of *tephrocotis*." It was not in the first plumage, however, but had just assumed the adult livery, with the peculiar features of the winter-dress. It was, however, only considered to be an abnormal specimen of the common species, until, in the summer of 1874, the writer received, from Mr. Charles E. Aiken, of Fountain, Colorado, four specimens of what was evidently the same species in the spring-plumage. The species was accordingly described as *L. atrata*, Ridgway, in the "American Sportsman" for July 18, 1874 (p 241).

The following is believed to be a nearly complete bibliography of the literature bearing directly upon the birds of this genus:

BIBLIOGRAPHY.

1831.

Swainson, William, and Richardson, John. Fauna Boreali-Americana, vol. II. The Birds, p. 265. [First species of the genus described as *Linaria* (*Leucosticte*) *tephrocotis* Swains., from a single specimen killed on the Saskatchewan, May, 1827.]

Pallas, Petro. Zoögraphia Rosso-Asiatica, II, 1831. [On pp. 21–23, "*Passer arctous*," with several "varieties" from the Kurile Islands and Unalashka, is discussed. Var. β 1 (p. 22), from the Kuriles, is very probably *L. atrata*; if not this, is one unnamed. Var. β. 2 (also from the Kuriles, p. 22), reads very much like *L. australis*. Var. γ (p. 23, tab. xl) is *L. griseinucha*.]

1838.

Bonaparte, C. L. A Geographical and Comparative List of the Birds of Europe and North America. London, Van Voorst, 1838. [*Erythrospiza tephrocotis*, p. 34.]

1839.

Audubon, John James. A Synopsis of the Birds of North America. [On p. 126, Swainson's specimen is redescribed as *Erythropiza tephrocotis*, Swains.]

——— Ornithological Biography; or, an Account of the Habits of the Birds of the United States of America, accompanied by Descriptions of the Objects represented in the Work entitled "The Birds of America," V, p. 232, pl. cccxxiv.

1841.

AUDUBON, JOHN JAMES. The Birds of America, from Drawings made in the United States and their Territories. III, New York, 1841. On page 176, Swainson's Saskatchewan specimen is redescribed and figured (pl. cxcviii) as *Erythrospiza tephrocotis*, SWAINS.

BRANDT, J. F. <Bull. Acad. St. Petersburg, Nov., 1841, p. 36.

1843.

GOULD, JOHN. On Nine New Birds collected during the Voyage of H. M. S. Sulphur. <Proc. Zoöl. Soc., London, 1843, 104. [*L. griseinucha*, accurately described under the name of "*L. griseogenys*." No locality is given.]

1850.

BONAPARTE, CAROLO LUCIANO. Conspectus Generum Avium. [The species described in this work are: (1) *L. tephrocotis*, SWAINS. (North America). (2) *L. brunneinucha*, BRANDT (Kamtschatka and Kuril Islands). (3) *L. griseinucha*, BRANDT (Russian America). (4) *L. arctous*, PALL. (Siberia and E. Europe). (5) *L. gebleri*, BRANDT (eastern Siberia).]

BONAPARTE & SCHLEGEL. Monographie des Loxiens. [The species are here ranged under *Montifringilla*, BREHM, as follows: (1) *M. griseinucha*, BRANDT (p. 35, pl. 41). (2) *M. brunneinucha*, BRANDT (p. 36, pl. 42.) (3) *M. tephrocotis*, SWAINS. (p. 37, pl. 43); (4) *M. arctoa*, PALLAS (p. 38, pls. 44, 45). The colored plates are excellent.]

1852.

BAIRD, SPENCER F. <Exploration of the Valley of the Great Salt Lake of Utah.—By Howard Stansbury, Capt. Corps Topog. Eng., U. S. A. Appendix C, Zoölogy; Birds, pp. 314–335. [On pp. 317–318, *Leucosticte tephrocotis*, SWAINS., is described from an adult male obtained by Captain Stansbury, March 21st, 1850, at Salt Lake City, being the first one secured since the capture of the original type of the species and genus!]

1858.

KITTLITZ, F. H. von. (?)

BAIRD, SPENCER F. Washington, 1858. Pacific Railroad Report, vol. IX, 4to, pp. 1005. [*L. tephrocotis*, Swains., described (pp. 430, 431) as a member of the U. S. fauna, based on specimens obtained by Captain Stansbury, at Salt Lake City, March 21, 1850. *L. griseinucha*, Brandt, and *L. arctoa*, Pall., are described in foot-notes.]

1868.

SALVADORI, TOMAS. "Description of a New Species of the Genus *Leucosticte*." <Proc. Zoöl. Soc. Lond., 1868, p. 579, pl. xliv. [A species (*L. giglioli*, SALV.) from Dauria is described (p. 579) and figured (plate xliv). It apparently belongs to the *L. arctoa* group, and, therefore, not a true *Leucosticte*, and probably a member of the subgenus *Hypolia*.]

1869.

DALL, WM. H., and BANNISTER, HENRY M. "List of the Birds of Alaska, with Biographical Notes." <Trans. Chicago Ac. Sc. I, ii, 1869, pp. 267–310, pls. xxvii–xxxiv. [On p. 282, an interesting account of the habits and notes of *L. griseinucha* is given; *L. littoralis* is also given in the list on the same page.]

BAIRD, SPENCER F. <Trans. Chicago Ac. Nat. Sc., 1869, p. 317, pl. 28, f. 1. [A new species, *L. littoralis*, Baird, described, from Sitka.]

1870.

BAIRD, SPENCER F. <Geol. Survey Cal., Ornithology, vol. I, pp. 160–166. [The North American species recognized are: (1) *L. griseinucha*, Brandt (p. 161); (2) *L. littoralis*, Baird, (p. 162). (3) *L. campestris*, Baird (p. 163); (4) *L. tephrocotis*, Swainson (p. 164), and (5) *L. arctoa*, Brandt (p. 165)—each illustrated by a colored, full-sized figure of the head.]

1872.

ALLEN, J. A. Ornithological Notes from the West. <American Naturalist, VI, June, 1872; II. Notes on the Birds of Colorado, pp. 342–351. ["Among the snow-fields of the higher parts of the mountains were found three essentially arctic species that were not met with below the region of snow. These were the tit-lark, the gray-crowned finch (*Leucosticte griseinucha*), and the white-tailed ptarmigan (*Lagopus leucurus*)."]

——— Notes on an Ornithological Reconnaissance of Portions of Kansas, Colorado, Wyoming, and Utah. <Bull. Mus. Comp. Zoöl., Cambridge, Mass., vol. III, No. 6, July, 1872, pp. 113–183.

[On p. 121, "*Leucosticte tephrocotis*" (=*L. australis*) is stated to have been "found breeding above timber-line in the mountains of Middle Colorado." VII. List of birds observed in the vicinity of Mount Lincoln, Park County, Colorado, from July 19 to July 26, 1871, with annotations; pp. 159–164. The same fact again mentioned, pp. 160 and 161; also on p. 162. Mr. Allen's views respecting the different forms of this genus are as follows (pp. 162–163): "The specimens (4 ♂, 2 ♀) of *Leucosticte* obtainted on Mount Lincoln differ very much in color from winter-specimens of *Leucosticte tephrocotis*, as well as from any figure or description of any form of *Leucosticte* I have seen. Whether they represent more than the breeding-plumage of *L. tephrocotis*, or a well-marked southern form of that species, I am at present uncertain, being without summer-specimens of that species. . . . . . . Different specimens vary considerably in the intensity and amount of red.* Besides wanting the gray nuchal collar, these specimens have the rosaceous of winter-specimens replaced by bright red, and the bill black instead of yellow.

"Since writing the above, I have had an opportunity of examining several specimens of *Leucosticte* killed at Central City, Colorado, in March, 1869, by Mr. F. E. Everett, and by him presented to the Boston Society of Natural History. Of three males, one (marked "young male") differs but little from the Mount Lincoln specimens, it having no ash on the head.† Another corresponds very nearly in color with the so-called *L. griseinucha*, and another nearly as well with the so-called *L. littoralis*.‡ Although these birds may have been born at widely-separated localities, it seems probable that many of the differences whereon certain species of *Leucosticte* have been founded may be only individual variations. It is to be noticed, however, that the amount of ash on the head and the intensity of the colors vary with locality from the north southward; the most southerly form having no ash on the head, the bill black instead of yellow, and the red of a brighter tint than those from more northern

* The variation noted is chiefly sexual; the males being much brighter than the females. —R. R.

† This is *L. australis*; it probably has a yellow or yellowish bill, and is an adult.—R. R.

‡ These are both undoubtedly *L. tephrocotis* var. *littoralis*.—R. R.

localities.* The type of *L. tephrocotis* was a male, killed on the Saskatchewan in May (see Faun. Bor.-Am., II, p. 266), in which the ash formed a narrow nuchal band.† In *L. griseinucha*, a more northern form, the gray involves nearly the whole head and the throat,‡ and in *L. littoralis* and *campestris* there is more gray on the head than in *tephrocotis*, and they also appear to be more northern in their distribution. In view of these facts, it seems probable that the Mount Lincoln specimens represent the smaller, brighter-colored, southern race, in which the ash of the head has entirely disappeared." [In this connection, see pp. 58, 59, of this monograph.]

1872.

COUES, ELLIOTT. "Key to North American Birds," p. 130. [Species admitted, (1) *L. tephrocotis*, SWAINS., and (2) *L. arctoa*, PALL.; under the former are ranged, as geographical races, var. *campestris*, Baird; var. *griseinucha*, Brandt; and var. *littoralis*, Baird. A note in the "Appendix" (p. 352) reads thus: "It is hardly necessary to recognize by name more than one variety of this bird; 'campestris' being referred to *tephrocotis* proper, and 'littoralis' to var. *griseinucha*."]

1873.

DALL, W. H. Notes on the Avifauna of the Aleutian Islands, from Unalashka eastward. <Pr. Calif. Acad. Sci. (adv. paper, February 8, 1873, p. 11). [Describes nest and eggs of *L. griseinucha* on p. 3.]

RIDGWAY, ROBERT. "The Birds of Colorado." <Bulletin Essex Institute, vol. V, Nov., 1873. [On p. 189, *L. tephrocotis* var. *australis*, ALLEN (MS. name) is characterized, being a new form from Mount Lincoln, Colorado.]

COUES, ELLIOTT. A Check List of North American Birds. Salem, Naturalists' Agency, 1873. [Two species of *Leucosticte* are catalogued, viz, *L. tephrocotis*, SW. (No. 144), and *L. arctoa* (PALL), (No. 145). The former has a var. *griseinucha*, BRANDT (No. 144[a]). The latter is not a North American Bird, and belongs to the subgenus *Hypolia*.]

1874.

BAIRD, SPENCER F., BREWER, THOMAS M., and RIDGWAY, ROBERT. "A History of North American Birds," vol. II, pp. 502–509. [The only species recognized as North American is *L. tephrocotis*, SWAINS., with var. *campestris*, BAIRD, var. *littoralis*, BAIRD, and var. *griseinucha*, BRANDT, as geographical races; a synoptical table of these is given on pp. 503, 504. The form now known as *L. australis* (Allen) was described in foot-note on pp. 504, 505, as being the breeding-plumage of *L. tephrocotis*—a supposition since proven to be entirely erroneous. *L. atrata*, RIDGW., of the present monograph was described on p. 505 as the young of *L. tephrocotis!* The former error was corrected in the appendix (vol. III, p. 509), though the form was only admitted to the rank of a geographical race, and called *L. tephrocotis* var. *australis*, ALLEN.]

* On the contrary, taking the three forms *tephrocotis*, *littoralis*, and *griseinucha*, which seem all to be referable to one species (*L. tephrocotis*), the most northern (*griseinucha*) of the two gray-cheeked forms has less gray on the head than the southern one (*littoralis*); in the former, the throat being always black, while in the latter it is sometimes entirely, and often mostly, ash; the northern form is also very much more brightly-colored than the southern one.—R. R.

† Reference to this plate shows that Richardson's specimen had a *black* bill; in this, as well as in all other respects, corresponding with spring-specimens from Colorado.—R. R.

‡ The throat is always black!

DALL, W. H. "Notes on the Avifauna of the Aleutian Islands, especially those west of Unalashka." <Pr. Cal. Acad. Sci. (advance paper, March 14, 1874, p. 12). [*L. griseinucha*, p. 4.—"I have observed no transitional forms in the Aleutian Islands which would connect this race with *littoralis*."]

RIDGWAY, ROBERT. "Description of a New Bird from Colorado." <American Sportsman, July 18, 1874, p. 241. (*Leucosticte atrata*, RIDGWAY.)

1875.

COUES, ELLIOTT. "Birds of the North-West: a Hand Book of the Ornithology of the Region Drained by the Missouri and its Tributaries." Washington, Government Printing-Office, 1875.* [The species recognized is *L. tephrocotis*, SWAINS., with races var. *tephrocotis* and var. *griseinucha*, BRANDT; under the former are included *campestris*, BAIRD, and *australis*, ALLEN, and in the synonymy of the latter *littoralis*, BAIRD.]

MATERIAL EXAMINED.

Considering that this genus has been until within a year or two past among the rarest in the North American *Ornis*, the material at the command of the author is peculiarly rich, and entirely sufficient to decide the lines between the species and the geographical races. The larger portion of the collection examined was kindly loaned for the purpose by Mr. Charles E. Aiken, of Fountain, Colorado, and Mrs. M. A. Maxwell, of Boulder, in the same Territory, and comprised immense series of specimens, obtained at different seasons in those and contiguous localities. The remainder of the collection was contributed by the National Museum at Washington; the Museum of Comparative Zoölogy at Cambridge, Mass. (for which thanks are due Mr. J. A. Allen of that establishment); and the private collection of Mr. George A. Lawrence of New York City, as well as that of the author. The total number of specimens compared at one time is a little more than four hundred, classed as follows:

Museum.	L. atrata.	L. tephrocotis.	L. littoralis.	L. griseinucha.	L. australis.	Total number of specimens.
National Museum	2	16	10	51	5	84
Museum of Comparative Zoölogy	....	3	....	....	5	8
Museum of the Boston Society	....	....	4	....	....	4
Museum of G. N. Lawrence	....	2	1	4	1	8
Museum of C. E. Aiken	3	80	41	....	94	218
Museum of Mrs. M. A. Maxwell	....	70	3	....	....	73
Museum of R. Ridgway	....	2	11	7	1	21
Total	5	173	70	62	106	416

Taking into consideration the many scattered specimens which have come under notice, the number of specimens actually examined in connection with the subject may be set down at about four hundred and fifty.

SPECIES AND RACES.

A very simple distinction between these two terms, as applied to definable forms, is adopted in the following pages, the test being inter-

* This work is dated "1874," but it was not issued until February, 1875.

gradation *versus* isolation. No specimens in any way intermediate between *tephrocotis* (in any of its forms) and *australis* have been found; consequently, they are held to be distinct specifically. On the other hand, there are numerous examples intermediate in different degrees (according to the individual) between *tephrocotis* and *littoralis;* which being the case, they cannot be considered distinct species, but, on account of the fact that they occupy separate countries during the breeding-season and that the intermediate specimens are found only along the line of junction of these areas, they must be recognized as definable geographical races. The same may prove to be the case regarding *littoralis* and *griseinucha;* while, as is the case with *L. australis*, *L. atrata* stands apart from the other forms. We have yet to see, however, specimens intermediate between *littoralis* and *griseinucha;* indeed, *tephrocotis* and *littoralis* are the only forms which we are certain do intergrade.

GEOGRAPHICAL VARIATION.

No one but Mr. Allen has attempted to show a correlation between the distinguishing characters of the different forms of this genus, and the recognized general laws of geographical variation;* and the few remarks of this gentleman upon the subject are far from stating the facts of the case. In his first discussion of the relationship of the Mount Lincoln specimens (*L. australis*), he says: "Although these birds may have been born at widely-separated localities, it seems probable that some of the differences whereon certain species of *Leucosticte* have been founded may be only individual variations. It is to be noticed, however, that the amount of ash on the head and the intensity of the colors vary with locality from the north southward; the most southerly form having no ash on the head, the bill black instead of yellow, and the red of a brighter tint from those of more northern localities. The type of *L. tephrocotis* was a male, killed on the Saskatchewan in May, in which the ash formed a narrow nuchal band. In *L. griseinucha*, a more northern form, the gray involves the whole head and the throat; and, in *L. littoralis* and *L. campestris*, there is more gray on the head than in *tephrocotis*, and they appear to be more northern in their distribution. In view of these facts, it seems probable that the Mount Lincoln specimens above described represent the smaller, brighter-colored, southern race, in which the ash of the head has entirely disappeared."—(Bulletin of the Museum of Comparative Zoölogy, III, No. 6, July, 1872, p. 163, foot-note.)

Regarding the subject of individual variation, we shall say little, since the immense series at our command shows that this is really insignificant; but, respecting the statements which follow, there is need of correction. There is no such variation from the north southward as that stated in the passage quoted; for the northern forms are quite as brightly colored as the most southern ones, while in the gray-headed races of *L. tephrocotis*, it is the more southern one (var. *littoralis*) which has the most gray. Thus, in this latter race the throat is more or less gray, frequently entirely gray; while, in var. *griseinucha*, the whole throat is black! Var. *griseinucha* is also much brighter-colored than its southern ally, the red

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* Consult on this subject the following authorities:
BAIRD, American Journal of the Arts and Sciences, XLI, March and January, 1866.
ALLEN, Bulletin of the Museum Comparative Zoölogy, Cambridge, ii, 1871, part iii.
RIDGWAY, American Journal of the Arts and Sciences, IV, December, 1872, p. 454; V, January, 1873, p. 39.—American Naturalist, VII, September, 1873, p.
COUES, American Naturalist, VII, July, 1873, p. 415.

being not only deeper and more extended, but the brown of the body is darker and richer! Regarding the black bill of the southern form, supposed by Mr. Allen to characterize it alone, we now know that in *all* the forms it is black in summer, while, even in *australis* itself, it is yellow in winter! The fact that *littoralis* has more gray on the head than *tephrocotis* cannot be explained by stating that the former is more northern in its distribution, for such is not the case, since the breeding-ground of var. *tephrocotis* is quite as far northward in the interior as that of var. *littoralis* is on the coast. We must, therefore, look to some other explanation of these variations than the laws of climatic modification which are now recognized.

The single instance of apparent correspondence to a general rule of geographical variation is seen in *L. griseinucha* of the Alaskan coast, which is more northern in its habitat than *L. littoralis* of the more southern North-Pacific coast, and is also larger in size.

Mr. Aiken's notes upon the relation of the several forms are worthy of publication, and are consequently presented *verbatim.**

"I sent to you, some ten days since, a box containing, besides some hawks, etc., over two hundred specimens of *Leucosticte;* these forming, with one or two exceptions, my entire series of the genus. So large a series, embracing as it does specimens from various localities and of different dates of collection, should, I think, throw considerable light upon the genus. Of *australis*, you will find specimens collected from February to May 15; and, of *tephrocotis*, from January to April. . . . . . . It seems to me that the chain connecting *tephrocotis* and *griseinucha*† is very complete, the gradation being almost imperceptible, and I see no good reason for admitting so many varieties *unless* these varieties are restricted during the breeding-season to distinct localities."‡

"Were it not that I dislike to believe in hybrids, I should think that *griseinucha* and *tephrocotis* were distinct species, and that the intermediate forms were the results of interbreeding. If *atrata* were a southern race of *tephrocotis*, would you not expect it to be smaller? On the other hand, it is, if any different, larger."

SEASONAL VARIATIONS.

The variations with season are so well defined and regular that they may be easily understood. In all the forms, the bill is yellow, black-tipped in winter, and uniform black in summer. In the latter season, the soft rosy pink of other seasons is changed to a more crimson or carmine hue, and the paler borders to the contour-feathers disappear. These facts borne in mind, another important one is to be impressed on the memory, *i. e.*, that *there is not the slightest alteration of the pattern!* In all the forms of *tephrocotis*, the gray of the head remains precisely the same throughout the year. *L. australis* never has any gray on the head, while it is probable that in *L. atrata* the same constancy of this feature obtains as in *L. tephrocotis*. The changes from the winter-dress to that of summer are thus explained by Mr. Aiken, before quoted: "Up to the 20th of March, all birds killed had the bill yellow; but in the last grand haul, on April 18, of more than three hundred and fifty specimens, all had a black or nearly black bill, so that the change in the color of

* Letter to the author, dated June 20, 1874, referring to the specimens transmitted for examination.

† At the time Mr. Aiken supposed his specimens of *littoralis* to be *griseinucha;* the latter he had not seen.

‡ Such proves to be the case.

the bill doubtless occurs about April 1." The notes on the specimens enumerated in the tables closing the accounts of the species will further explain the time during which this change is made.

INDIVIDUAL VARIATION.

There is no noticeable range of individual variation among typical examples of any form, and it is only the transitional specimens connecting two races of one species that vary at all from the normal standard. A series of this nature connects var. *tephrocotis* with var. *littoralis*, different specimens exhibiting different degrees of relationship to the two forms. The *L. campestris* of Baird (see Ornithology of California, I, 1870, 163) is of this character. The amount of individual variation in size is shown by the tables of measurements annexed to the account of each species.

SEXUAL DIFFERENCES.

The American species of this genus fall into two distinct groups, according as the sexes do or do not differ in appearance. In *L. tephrocotis*—in all its forms—there is not the slightest sexual difference; but in *L. atrata* and *L. australis*, the distinction is very marked.

As a rule, the female is very slightly smaller than the male; but that she is not constantly so is clearly shown by the following tables of the averages of the measurements of large series of each form:

	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No of specimens.
L. ATRATA.						
Both sexes	4.02	2.97	.43	.77	.59	5
Male	4.20	3.05	.43	.75	.58	2
Female	3.90	2.90	.44	.79	.60	3
L. TEPHROCOTIS.						
Both sexes	4.11	3.00	.46	.79	.57	155
Male	4.21	3.12	.45	.79	.59	23
Female	4.16	3.12	.46	.79	.58	34
L. LITTORALIS.						
Both sexes	4.03	2.95	.46	.77	.59	48
Male	4.08	2.98	.47	.79	.59	7
Female	4.07	2.98	.47	.79	.59	7
L. GRISEINUCHA.						
Both sexes	4.49	3.49	.57	.95	.71	46
Male	4.48	3.49	.57	.98	.70	27
Female	4.48	3.49	.56	.95	.73	13
L. AUSTRALIS.						
Both sexes	4.15	3.09	.45	.77	.57	106
Male	4.20	3.10	.45	.77	.58	69
Female	4.17	3.14	.47	.76	.57	36

GEOGRAPHICAL DISTRIBUTION.

The portion of the North American continent which the birds of this genus inhabit during the breeding-season lies chiefly to the northward of the United States and west of the Atlantic drainage of British America. In the United States, they are limited to the elevated mountain-ranges and plateaux of the Western Region; one or two species (*L. australis* and possibly *L. atrata*) inhabiting the alpine summits during summer, and all but one of them (var. *griseinucha*) following the bases of the mountain-ranges southward in their winter-migrations. The extent of their southward migration is not known; but, from the fact that they are excessively abundant in portions of Colorado, while one species (*australis*) has been obtained even in New Mexico, it is possible that they extend their migrations southward to the limit of arctic winter climate on the high mountain-summits.

The alpine summits of Colorado appear to be the southern limit to their summer-distribution; but here they are restricted at this season to an altitude of 12,000 feet and upward. In the same country, the resident species (*L. australis*) migrates chiefly to the base of the mountains, or about 3,000 to 6,000 feet lower. In the main Rocky Mountain chain, all the migratory forms (*L. tephrocotis* var. *tephrocotis* and var. *littoralis*, *L. atrata*, and *L. australis*) occur together during the winter-season, even mingling in the same flock! *L. tephrocotis* (proper) comes from directly northward; var. *littoralis* from the northwest, and *L. australis* from the summits of the peaks. It is uncertain whence *L. atrata* comes, but its breeding-ground is probably the high mountains toward the northern border of the United States. These forms are mixed in winter probably throughout the Rocky Mountain system, since var. *tephrocotis* has been obtained (in March) at Salt Lake City on the very verge of the desert basin; while *L. atrata* has been obtained (in September) on the Uintah Mountains just to the eastward. Westward of the eastern border of the Great Basin, it is probable that var. *littoralis* very largely predominates, or that it entirely replaces the other forms. The southernmost locality in the Sierra Nevada at which the latter form has been seen in winter is the vicinity of Lake Tahoe, in the Washoe Spur, latitude about 39° north. At that place they were said to have been abundant during the cold winter of 1861–'62; and a specimen from there came into the possession of Mr. F. Gruber, of San Francisco, by whom it was presented to the German Academy of Natural Sciences in that city (see Ornithology of California, I, 1870, p. 161). At Virginia City, Nevada, only a few miles to the eastward, a large flock was seen by the writer in January, 1868, fluttering over the snow in the outskirts of the town, precisely after the manner of Longspurs (*Plectrophanes lapponicus*). It is not absolutely certain that these birds were var. *littoralis*, as none were secured; they were, however, all gray-headed birds. The Lake Tahoe specimen may possibly also have been var. *tephrocotis*, but the geographical location of the country is more in favor of its being the other form.*

*A collection of these birds recently received from Captain Bendire, obtained at Camp Harney, eastern Oregon, comprised nine specimens, of which all but one were typical *littoralis;* the single specimen being of the "*campestris*" style. Four specimens sent by Captain Bendire, from the same place, to the Boston Society of Natural History, were all true *littoralis*. Six specimens received at the National Museum from Fort Saunders, Wyoming Territory, collected by Dr. A. G. Brackett, included three of *littoralis* and the same number of *tephrocotis*.

The range during summer of several of the forms is not so well understood. The exact breeding-ground is known only of *L. australis* and *L. griseinucha;* that of the latter being the Aleutian Islands and neighboring mainland of Unalashka, and of the former the alpine summits of the Colorado peaks. Regarding the others, we can only conjecture where they breed from what is known of their distribution at other seasons, and the time and direction of their migrations. We can guess more nearly in the case of *L. tephrocotis* var. *tephrocotis* than any other. It was obtained by Mr. Aiken in Colorado in April, during its northward passage, already in possession of the summer-attire. In May, Richardson found it on the Saskatchewan, while Mr. J. K. Lord observed in July what was probably this race on the summit of the Rocky Mountains, near the Kootanie Pass, just south of the northern boundary of the United States. At that locality several young-of-the-year were shot. We therefore judge that the breeding-ground of var. *tephrocotis* is the Rocky Mountain region of British America, and perhaps the extreme northern Rockies of the United States. The var. *littoralis* occurs in winter with var. *tephrocotis* throughout its southward range; its abundance increasing to the westward, however. We have seen it in the winter-plumage from Kadiak and Sitka of the Alaskan coast, from Fort Simpson, British Columbia, Idaho, Wyoming, and Colorado; while it is known to extend in very severe winters as far southward as the parallel of 39° in the Sierra Nevada and contiguous ranges to the eastward. On the Cascade Mountains, Mr. J. K. Lord found them in October. In the summer-plumage, this race has been obtained only in Colorado, where Mr. Aiken shot it in flocks of *tephrocotis* as they were passing to the northward. From the fact that it has been found in winter along the northwest coast from Kadiak southward, it is extremely probable that the breeding-ground of this race is the coast-system of mountain-ranges of southern Alaska and British Columbia, possibly extending southward to the alpine summits of the Cascades of Washington Territory and Oregon. The *L. atrata* has been obtained at only two localities, the Uintah Mountains, in September, and the mountains of Colorado, in April; it is therefore probable that the breeding-ground of this species will be found in the northern Rocky Mountains of the United States, or possibly an associate of *L. tephrocotis* at the southern limit of the latter, and of *L. australis* at its northern limit. It is not known how far to the southward *L. australis* breeds, but probably on all the peaks of the southern Rockies whose summits rise to above the timber-line.

Mr. Aiken's notes pertaining to the distribution of these birds are of interest, and are herewith appended:

"I think that none of *australis* were seen before March, and then only a few. In February, about 75 per cent. of all the *Leucostictes* were *tephrocotis*, and the remainder the gray-cheeked varieties.* In the flock at Cañon City in April, I judged that about 1 per cent. were *atrata;* 30 per cent. *tephrocotis;* 8 or 10 per cent. *littoralis;* and the remainder *australis*. In this flock, the males and females of the last-named were about equal in number; but of *tephrocotis* the number of females was double that of the males. From these facts, and information derived from other sources, I infer that the gray-cheeked variety (*littoralis*) is the most northern race, and that many of them do not find their way so far south except in severe winters. In this belief I am strengthened by the fact that, of sixty birds killed in Wyoming in 1870, all but one or two were typical *tephrocotis;* that *tephrocotis* occupies, during the breeding-season, a more

* *Littoralis* and "*campestris*" (= *littoralis*).

southern locality than the preceding, and winters regularly in the Rocky Mountains of Colorado, and even farther south; that *australis* inhabits the next lower section, breeding in Colorado, and probably extending into the British possessions, but wintering, for the most part—especially in severe winters—south of this Territory; that *atrata*, if anywhere common, must occupy a still more southern locality."

BIOGRAPHY.

The habits of the birds of this genus are, at present, only very imperfectly understood, few observers having enjoyed an opportunity to study them. The *L. tephrocotis* var. *griseinucha* is the only form whose habits during the breeding-season have been recorded, and whose eggs and young plumage have been seen. *L. australis* has been found in summer at its breeding-ground by several collectors; but unfortunately none of them found its eggs or saw the birds in the exact locality where they bred, so that they were unable to throw any light upon the subject. The other forms are known only as migrants.

The *L. tephrocotis* var. *griseinucha* inhabits, during summer as well as other seasons, the coast and islands of Alaska, the Aleutians and the Unalashka main being its center of abundance. Mr. Dall, the author of "Alaska and its Resources," furnishes the first account of the habits of this bird in his paper on the birds of Alaska (Transactions of the Chicago Academy of Sciences, I, ii, 1869, p. 282.) His account is as follows:

"This species abounds on the Pribylov and Aleutian Islands. A number of specimens were obtained on Saint George's, in August, although they were molting at the time. This beautiful bird had no song at that season, except a clear chirp, sounding like 'Wéet-a-wéet-a-wée-weet.' It was on the wing a great part of the time, avoiding lighting on the ground, but darting rapidly in a series of ascending and descending curves, now swinging on the broad top of an umbelliferous plant, and now alighting on some ledge of the perpendicular bluff, jumping from point to point, and seemingly delighting in testing their own agility. Their nest is a hollow on one of these ledges, provided with straws or bits of moss. They lay four white eggs in May. In August, the young were fully fledged. They are graminivorous apparently; but I found two or three small beetles in the crop of one which I skinned."

Mr. Elliott, in his report on the Pribilov or Seal Islands of Alaska, thus remarks upon the habits of this bird, as observed by himself on the islands of Saint George's and Saint Paul's:*

"This agreeable little bird, always cheerful and self-possessed, is a regular and permanent settler on the islands, which it never leaves.

"In the depth of dismal winter, as well as on a summer's day, the pahtoshkie greets you with the same pleasant chirrup, wearing the same neat dress, as if determined to make the best of everything. It is particularly abundant on Saint George's, where its habits may be studied to best advantage.

"The pahtoshkie nests in a chink or crevice of the cliffs, building a warm, snug home for its little ones of dried grasses and moss, very neatly put together, and lined with a few feathers.

"The eggs vary in number from three to six, being generally four. They are pure white, with a delicate rosy blush when fresh, and measure .97 by .67 inch.

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*Government Printing-Office, Washington, 1873. See ornithological portion of the report, edited by Dr. E. Coues.

"The young break the shell at the expiration of twenty or twenty-two days' incubation, the labor of which is not shared by the male, who, however, brings food to his mate, singing the while, as if highly elated by his prospects of paternity.

"The chicks, at first, are sparsely covered with a sprinkling of dark-gray down, and in two or three weeks gain their feathers, fitting them for flight, although they do not acquire the bright rosy hues and rich brown of the parents the first year.

"Between the old birds there is no outward dissimilarity according to sex; the male and female being exactly alike in size, shape, and coloration. They feed upon various seeds and insects, as well as the larvæ which swarm on the killing-grounds. They are fearless and confiding, fluttering in the most familiar manner around the village huts.

"In the summer of 1873, a pair built their nest and reared a brood under the eaves of the old Greek church at Saint George's.

"The nests, of which I collected fifteen or twenty, are very neatly made up of dry grass and moss, thick and compactly interwoven, placed on the faces of the basaltic and breccia cliffs which rise from the shore-line of the islands. These disintegrating tufa and breccia bluffs afford a thousand and one little pockets and crannies, in which the pahtoshkie builds, secure from molestation from prowling foxes. It has no song, but utters a low mellow chirp, alike either when flying or sitting. It is most abundant on Saint George's, where hundreds may be seen at any time during a short walk along the north shore. It consorts in pairs throughout the year, never going in flocks, and seldom flying or feeding alone."

The *L. australis* was found breeding on the alpine summits of the Colorado Mountains by Mr. Allen, Mr. Batty, and Dr. Rothrock; but only the latter has favored us with the benefit of his observations. "The following interesting notes are given by Dr. Rothrock, who found the species very abundant in the mountains back of Fairplay in the South Park, and also on Mounts Harvard, Evans, Red Mountains, and elsewhere. These birds are, in habitat, the associates of the white-tailed ptarmigan, and, like that bird, are never found below the timber-line in summer, ranging thence upward to the summits of the highest peaks. It is never found singly, but usually in flocks of from six to thirty, and rarely far away from large bodies of snow; its favorite resort being the edge of snow-banks, where they find grass-seeds, and also a small black coleopterous insect. Even when found among the scrub-pines, which was rarely the case, it was noticed that they seldom alighted in a tree, but kept constantly on the ground. At all times, they were rather shy and suspicious. The specimens taken were all in breeding-dress."*

The habits in winter seem to be much the same in all the forms, and at this season several of them associate in the same flock in the Rocky Mountain region. Mr. C. E. Aiken, who has probably enjoyed better opportunities for studying them at this time than any other observer, has kindly favored us with the following very interesting description:†

"The first information that I had of this genus was derived from specimens sent to Mr. Holden from Wyoming Territory, in 1870, as related in my last letter. The next was in February, 1872, when I saw and

* Report upon Ornithological Specimens collected in the years 1871, 1872, and 1873, by Dr. H. C. Yarrow and Mr. H. W. Henshaw, Naturalists to the Geographical and Geological Explorations and Surveys West of the One Hundredth Meridian. First Lieut. George M. Wheeler, Corps of Engineers, U. S. A., in charge. Washington, Government Printing-Office, 1874. P. 79.

† Letter dated "Colorado Springs, Colorado, July 13, 1874."

killed a single female of *australis*. Next, one frosty morning about the middle of December, I saw a single bird which I failed to secure. On the 3d of January, 1874, we had a severe snow-storm, and the next morning I found a large flock of Shore-Larks (*Eremophila*) flying about a piece of plowed ground below the house from which the wind had blown the snow. On going down to examine the flock, I found five or six *Leucostictes* among them. I shot one, a *tephrocotis*, and at the report of the gun the others separated from the flock of Shore-Larks and disappeared in the distance. In the course of the day, two other *Leucostictes* joined the flock of *Eremophilas*, one of which (No. 1764)* I killed. I also shot from this flock three *Plectrophanes lapponicus*, the only ones seen in the Territory, and one *P. maccownii*. Soon after this I learned that these birds (*Leucostictes*) were daily seen in the town of Colorado Springs, and on going up there saw them myself. Every morning they came, usually only one or two at a time, to pick up crumbs in the door-yard, and fearlessly ventured on the porch for seeds that fell from a canary-cage hung there; indeed, so tame were they that they would pick seeds at my very feet as I dropped them from my hand. During two days that I remained in town I caught five alive under a common flour-sieve, and, after leaving, others were caught in the same manner by a friend, and sent to me at the ranch. By the 20th of March, all these birds had disappeared at Colorado Springs; but, about the last of March, my sister, returning from a visit to Cañon City, informed me that they were very abundant at that place, but when I went down there on the 12th of April none were to be seen, and had it not been for the great storm which began on the 15th I should not have seen any more this year. I was camping in a 'shanty' four miles from town, and, after being snowed up for four days, forced my way into town on horseback, and lodged with a friend. The next morning I discovered a small flock of *Leucostictes* on the graveled walk before the house, and by noon this flock had increased to the number of probably a thousand individuals. By this time I had managed to borrow a gun, and in three or four hours had killed no less than three hundred and fifty, when I desisted. Fifteen and twenty were often killed at a single discharge, and at one time twenty-eight were killed with one barrel. My friend followed me about with a piece of board upon which he gathered the birds as I killed them. They were gathered into one large flock, and at the discharge of the gun would rise from the ground like a flock of Shore-Larks, all chirping and whistling, and after whirling a few times in the air would alight again, generally upon a tree or fence, whence they would flock down to the ground. I have since learned that this flock remained about town several days, until the snow disappeared, when they left as suddenly as they came.

"I am informed that these birds are common in winter in the mountain-towns, flocking into the streets and door-yards in stormy weather, and disappearing when the snow does. I think that their unusual abundance at the base of the mountains this winter was caused by storms in the mountains. In May, an acquaintance sent me two skins (Nos. 1633 and 1599) from Twin Lakes, showing that they are found in the mountains long after they disappear below. I have just returned from a trip to the Wet Mountain branch of the Snowy range, where I expected to find *australis*, and perhaps its eggs, but was unsuccessful. I wrote you last year about seeing one of the genus on Pike's Peak.

* This specimen was not sent me by Mr. Aiken, consequently I cannot say what species it was.

"The *Leucostictes* appear in winter to be most at home on the ground, though they alight readily upon trees, fences, or buildings. A storm gathers them into a dense flock, when their habits are much like those of the Shore-Larks; but, on the return of pleasant weather, the flocks are dispersed, and the birds are found singly or in small companies. They look pretty and lovable, hopping about one's door-step, in their bright plumage and cute and confiding manners. They come nearer filling my childhood's idea of the chick-a-dee-dee than any other bird I know of. They move on the ground with quick, short hops, their feet so closely drawn up into their ruffled feathers as to be almost invisible. They are very fond of hemp and canary seed, from which they remove the shells almost instantly. One that was put into a cage readily adapted itself to confinement, but when others were placed with it they all fluttered about so as to ruin their plumage, and were then liberated. I intended to have kept several through the season in order to note changes which might occur in the plumage. I have several times heard one of them sing, a pretty, warbling song, somewhat like that of the canary, but so low as hardly to be heard at a distance of more than two or three rods.

"All the varieties mingle indiscriminately in the same flock, and I could not detect any difference in their habits or actions. The proportion of adults was much greater in early spring than later in the season. You will see that by arranging the birds sent you according to their dates."*

GENUS LEUCOSTICTE, SWAINSON.

Linaria† (*Leucosticte*), SWAINS., F. B. A., II, 1831, 265 (type *Linaria tephrocotis*, SW.).

Leucosticte, SWAINS., Classif. B. II, 1837, 281.—BONAP., Consp., 1850, 536.

Passer,‡ sp., PALLAS, Zoög. Rosso-Asiat., II, 1831, 23 ("*arctous*, var. γ," = *griseinucha*).

Erythrospiza,§ sp., BONAP., Comp. List, 1838.—AUD., Synop., 1839; B. Am., III, 1841, 176.

Fringilla,‖ sp., AUD., Orn. Biog., V, 1839, 232.

Montifringilla,¶ sp., BONAP. et SCHLEG., Monog. Loxiens, 1850, 35–37.

GENERIC CHARACTERS.—*Form:* Bill conical, rounded, the tip rather blunt; the culmen slightly convex (but appreciably depressed about the middle portion); the gonys straight, and the upper tomium slightly concave; *lower mandible with a distinct linear ridge on each side*, originating at the lower posterior angle, and extending obliquely forward and upward to the tomium in a direction nearly parallel with the gonys; upper mandible with a similar but much less conspicuous ridge, originating just above the nostril, and running forward parallel with the culmen. Nostrils concealed by a conspicuous tuft of rather short antrorse feathers. Tarsus a little less than twice the culmen, and considerably exceeding the middle toe without its claw; lateral toes equal, their claws reaching only the base of the middle claw; posterior toe about equal in length to the lateral toes, but stouter; the nail much larger and more curved; claws moderate, of usual length and curve

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* Mr. Aiken may or may not have been right in considering the dully-colored specimens young individuals; it is possible that they may be birds of the preceding year, but they are not in the young plumage, which is totally different.

†*Nec* BECHST, 1802 (type *Fringilla cannabina*, L.)

‡*Nec* BRISSON, 1760 (type *Fringilla domestica*, L. = *Pyrgita*, Cuvier, 1817!).

§*Nec* BONAP., 1850 (type *E. obsoletus* LICHT.)

‖*Nec Linnæus*, 1735 (type *Fringilla cœlebs*, L.)

¶*Nec* BREHM, 1828 (type *Fringilla nivalis*, LINN.).

front of the tarsus with about eight scutellæ; the posterior face entire. Wing long and pointed, considerably longer than the tail; first three primaries longest, of nearly equal length, and abruptly longer than the fourth, the first, usually, but sometimes the second, longest; tertials not exceeding the secondaries. Tail medium, decidedly shorter than the wing, much emarginated or slightly forked; the lateral pair, or the next, longest; coverts lengthened, extending more than halfway to the tip. Plumage in general full and blended, but not compact; feathers of the pileum somewhat elongated. *Colors*: In the adult, prevailing color brown or blackish, becoming dusky on the forehead; lesser and middle wing-coverts, upper and lower tail-coverts, and feathers of the rump, abdomen, and flanks tipped with red or rosy (the shade varying according to the individual or the season); greater wing-coverts broadly skirted with red (very adult) or dingy ochraceous (in younger individuals); remiges and rectrices dusky, more narrowly-skirted with reddish or whitish. *In spring and summer*, the bill uniform black, the red tints inclining to bright carmine, and the contour-feathers without paler margins; *in fall and winter*, the bill yellow, pointed with dusky, the red tints of a rose or peach-blossom-pink shade, and the contour-feathers more or less distinctly bordered with a paler shade. *In the young* (of *L. griseinucha*—the others not seen), the plumage uniform brownish gray, with very faint pinkish edgings to the wing-feathers.

The genus *Leucosticte* stands somewhat apart from the genera to which it is most nearly related. Its nearest kindred are *Ægiothus*,* *Chrysomitris*,† *Pinicola*,‡ *Carpodacus*,§ and *Montifringilla*,|| the first and last of these being those to which it is most nearly allied. From *Ægiothus* it differs conspicuously, in much more robust and obtuse bill, with its outlines more convex, in the less development of the nasal plumes, shorter lateral toes, longer tarsus, less development of the claws, different system of coloration, and larger size. To *Montifringilla* the resemblance is closer, it being, like this form, of terrestrial habits instead of chiefly arboreal, like the others. The chief differences from *Montifringilla* consist in the very different coloration, more emarginated tail, and concave, instead of strongly convex, superior tomium of the bill, which, in *Montifringilla* and all the other allied forms, lacks the oblique ridge on the base of the lower mandible.¶

Of the species usually assigned to the genus, one—*L. arctoa* (PALL.)—differs in form, lacking the ridges on the side of the lower mandible, while the colors are normally different, the wings and tail being hoary whitish on the outer webs, and the feathers of the posterior parts of the body lacking the rosy tips. The *L. giglioli*, SALVADORI (Proceedings of the Zoological Society, London, 1868, pp. 579–580, pl. xliv), agrees with *L. arctoa* in the bill and in lacking the rosy tips to the posterior contour-feathers. *L. brunneinucha* (BRANDT) is a true *Leucosticte*; but to which group the two remaining Old-World species, *L. hæmatopygia* (GOULD) and *L. brandti*, BONAP., belong, I am not at present able to decide.**

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* *Ægiothus*, CABANIS, 1851. Type, *Fringilla linaria*, LINN.
† *Chrysomitris*, BOIE, 1828. Type, *Fringilla spinus*, LINN.
‡ *Pinicola*, VIEILLOT, 1807. Type, *Fringilla enucleator*, LINN.
§ *Carpodacus*, KAUP, 1829. Type, *Fringilla erythrina*, PALL.
|| *Montifringilla*, BREHM, 1828. Type, *Fringilla nivalis*, LINN.
¶ I find a decided indication of this ridge, however, in specimens of *Chrysomitris barbata* (MOL.) and *C. tristis* (LINN.).
** The smooth-billed *Leucostictes* may properly be considered as a distinct subgenus for which the name *Hypolia* is here proposed (ὑπο, under; λεῖος, smooth).

Restricting the genus, then, to the American forms and a single Siberian ally (*L. brunneinucha*), the following species and geographical races may be defined:

COMMON CHARACTERS.—Feathers of the rump, abdomen, and flanks, lesser and middle wing-coverts, and upper and lower tail-coverts, broadly tipped with rose-red, the concealed portion being clear dusky; greater wing-coverts, remiges, and rectrices clear blackish dusky, narrowly skirted with rosy or whitish; anterior portions of the body uniform brown or dusky.

A. *Nasal tufts white:*

a. Head partly silvery gray:

1. L. ATRATA, Ridgway.—Sexes very dissimilar. *Male:* prevailing color black, the dorsal region with a sooty cast. *Female:* prevailing color dull slate, the back more brownish; rosy markings of the male nearly obsolete. Gray of the head (both sexes) confined to the posterior and lateral portions of the pileum. Wing, 3.80–4.20 (4.02*); tail, 2.80–3.15 (2.97); culmen, .40–.45 (.43); tarsus, .75–.80 (.77); middle toe, .55–.60 (.59). *Hab.*—Uintah Mountains, Utah, September, Dr. HAYDEN; Cañon City, Colorado, April 18–20, C. E. AIKEN.

2. L. TEPHROCOTIS, Swainson.—Sexes alike; prevailing color reddish brown, varying from a raw umber shade to chocolate, chestnut, or reddish sepia; gray of the head extremely variable in extent. Wing, 3.80–4.85; tail, 2.70–3.90; culmen, .40–.62; tarsus, .75–1.00; middle toe, .50–.75. *Hab.*—Entire area of the northwestern countries of North America, and southward in the Rocky Mountains of the United States at least to latitude 38°.

* *Gray of the head strictly confined to the posterior and lateral portions of the pileum* (*as in* L. ATRATA):

Prevailing color varying from raw umber to reddish chocolate. Wing, 3.80–4.40 (4.11); tail, 2.75–3.30 (3.00);† culmen, .40–.50 (.46); tarsus, .75–.86 (.79); middle toe, .50–.65 (.57).‡ *Hab.*—In summer, the interior of British America (Saskatchewan, May, SWAINSON); in winter, the entire Rocky Mountain region of the United States, chiefly the eastern slope, southward to at least latitude 38° (Cañon City, Boulder, and adjoining places in Colorado, in February, March, and April, C. E. AIKEN and Mrs. MAXWELL; Fort Saunders, Wyoming, A. G. BRACKETT; Sherman, Wyoming, C. H. HOLDEN; Fort Laramie, Wyoming, and Deer Creek, Dr. HAYDEN; Salt Lake City, Utah, Captain STANSBURY).

var. *tephrocotis*, SWAINSON.

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* The figures inclosed in parentheses denote the *average* of the whole series of specimens measured.

†One hundred and fifty-five specimens.

‡ One hundred and sixteen specimens.

***Gray of the head extended over the auriculars and cheeks :*

Throat gray, or black more or less mixed with gray.—General color chestnut-brown. Wing, 3.80–4.30 (4.03); tail, 2.70–3.30 (2.95); culmen, .40–.50 (.46); tarsus, .70–.85 (.79); middle toe, .50–.60 (.59).* *Hab.* In summer, unknown, but probably the northwestern mountain-region in British Columbia and neighboring districts; in winter, northwest coast from Kadiak southward, and the mountains of the Middle Province of the United States, south to about latitude 38° (Boulder, Colorado, Mrs. MAXWELL; Central City, Colorado, C. E. AIKEN; Gilmer, Wyoming, H. R. DURKEE; Virginia City, Nevada, January, R. RIDGWAY)........................var. *littoralis*, BAIRD.

Throat black, not mixed with gray.—General color chestnut-sepia. Wing, 4.20–4.85 (4.49); tail, 3.15–3.90 (3.49); culmen, .50–.62 (.57); tarsus, .85–1.00 (.95); middle toe, .65–.75 (.71). *Hab.*—In summer, Aleutian Islands (Saint Paul's and Saint George's, breeding, H. W. ELLIOTT); in winter, coast of Alaska, from Unalashka to Kadiak, W. H. DALL, Dr. MINOR, and F. BISCHOFF).....(var.?) *griseinucha*, BRANDT.

b. Head without any gray:

3. L. AUSTRALIS (Allen).—Sexes very dissimilar. *Male :* general color raw umber, the throat inclining to maroon-purple and sometimes tinged with carmine; pileum grayish dusky, the borders of the feathers more grayish, becoming black on the forehead. *Female :* very much paler and duller, the rosy markings almost obsolete. Wing, 4.00–4.40 (4.15); tail, 2.80–3.35 (3.09);† culmen, .40–.48 (.45); tarsus, .70–.80 (.77); middle toe, .55–.60 (.57).‡ *Hab.*—In spring and summer, the Rocky Mountains of Colorado, breeding above the timber-line, at an altitude of 12,000 feet, ALLEN; Cañon City and vicinity, February to May 15, AIKEN; New Mexico, Lieut. WHEELER.

B. *Nasal tufts black :*

4. L. BRUNNEINUCHA, Brandt.—Whole head blackish; nape rufous; otherwise colored like *tephrocotis.* Wing 4.00; tail, 2.80 (*fide* BONAPARTE & SCHLEGEL, "Monograph des Loxiens," p. 36). *Hab.*—Eastern Kamtschatka and Kuril Islands.

LEUCOSTICTE ATRATA, RIDGWAY.

BLACK GRAY-CROWNED LEUCOSTICTE; AIKEN'S LEUCOSTICTE.

? *Passer arctous*, *β*, 1, PALLAS, Zoög. Rosso-Asiat., II, 1831, 22 ("Ex insulis Curilis").

Leucosticte tephrocotis (young), BAIRD, BREWER, & RIDGW., Hist. N. Am. B., I, 1874, 505.

Leucosticte atrata, RIDGWAY, Am. Sportsman, July 18, 1874, p. 241.

Hab.—Cañon City, Colorado (April; AIKEN); Uintah Mountains, Utah (September; HAYDEN).

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* Forty-eight specimens.

† One hundred and six specimens.

‡ Fifty specimens.

Sp. ch.—Gray of the head confined to the lateral and posterior portions of the pileum (as in *L. tephrocotis* var. *tephrocotis*); sexes very dissimilar in shades of coloration; general color black in the male, dusky slate in the female. Wing, 3.80–4.20 (4.02); tail, 2.80–3.15 (2.97); culmen, .40–.45 (.43); tarsus, .75–.80 (.77); middle toe, .55–.60 (.59).

Male: General color black, darker than the frontal patch, deepest anteriorly. Wing, 4.20; tail, 3.00–3.15 (3.05); culmen, .40–.45 (.43); tarsus, .75; middle toe, .55–60 (.58).

Female: General color dusky slate, lighter than the frontal patch, and with a faint brownish cast on the dorsal region. Wing, 3.80–4.00 (3.90); tail, 2.80–3.00 (2.90); culmen, .42–.45 (.44); tarsus, .75–.80 (.79); middle toe, .60.

The first specimen of this species which came to my notice was the on described in the "History of North American Birds" (vol. I, p. 505), as probably the young of *L. tephrocotis* var. *tephrocotis*. At the time when this description was penned, strong doubts were entertained as to its being really that species. The specimen was in molting plumage, however, and was then considered a bird of the year, exchanging the immature dress for the winter livery of the adult, the latter nearly complete. The following remarks relating to this specimen, quoted from the page cited above, show how strongly the propriety of referring it to *tephrocotis* was doubted: "Were it not unmistakably a bird of the year, it would be considered almost a distinct species, so different is it from adult specimens of *tephrocotis*." This specimen was obtained by Dr. Hayden's party, on the Uintah Mountains, Eastern Utah, September 20, 1870 (No. 60638, National Museum). No other specimens were seen, until, in July, 1874, Mr. C. E. Aiken sent from Colorado Springs, Colorado, four specimens, collected in April at Cañon City, in that Territory. These specimens and the one mentioned above led to the description of a new species of the genus in the "American Sportsman," as above cited.

The skins sent by Mr. Aiken are in the nuptial plumage, which may be taken as an indication that the species breeds in Colorado. The pattern of coloration is precisely similar to that of *L. tephrocotis*, but the totally different tints (black or dusky slate, instead of chocolate-brown), and the very marked difference between the sexes, separate it at once as a distinct species. It may be suggested that it is a melanism of *tephrocotis;* but, if this were so, there would be no such entire uniformity of characters as is exhibited throughout the series of five specimens, while in *tephrocotis* there is not the slightest sexual difference in colors.

In the winter-plumaged specimen (No. 60638, Nat. Mus.), there is almost as much pink on the abdomen as in *L. australis*, while the lesser wing-coverts seem to form a uniform patch of this color—a delicate, soft, peach-blossom-pink shade; the greater coverts and tertials are broadly edged with pale clay-color, while the scapulars are widely bordered with the same; the feathers of the breast are widely bordered with dull whitish, and the feathers of the neck, all round, have narrower borders of the same. The gray of the head is not so sharply defined as in the spring male, but it is about the head that the most traces of the immature plumage remain. The bill is dull yellow, with a dusky tip.

In the adult female, in spring, there is a less sharp outline to the ash of the pileum, and the demarkation between this and the dusky frontal patch is not distinct, the dusky shading gradually along the medial line into the color of the occiput.

It is possible that this species may be the same bird described by Pallas (Zoög. Rosso-As., II, 22) as "*Passer arctoa*, β, 1," as follows: "Ex

insulis Curilis: *vertice* nigricante, *cervice* cano-albida, *dorso* fusco grysoque nebuloso; *subtus* nigra, pectoris lituris albis, ventris et uropygii cinnabarinus, crisso cinnabarino, lituris fuscis. *Alarum* remiges, tectrices et vestrices ora cinnabarea marginatæ; remiges intimæ margine albido." This description corresponds well with the plumage of the adult male in winter-dress. Should it prove to be the same as *L. atrata*, the range of this species will be greatly extended.

List of specimens examined.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
1537	♂	C. E. A*	Colorado	April 20	4.20	3.15	.40	.75	.60	Black.
60638	♂	U. S.†	Uintah Mts	Sept. 20	4.20	3.00	.45	.75	.55	Yellow.
1777	♀	C. E. A	Colorado	April 18	4.00	3.00	.45	.80	.60	Black.
1778	♀	..do	..do	April 18	3.90	2.90	.42	.75	.60	Black.
	♀	..do	..do	April 18	3.80	2.80	......	.80	......	Black.

* C. E. Aiken. † U. S. National Museum.

LEUCOSTICTE TEPHROCOTIS, SWAINS., VAR. TEPHROCOTIS, SWAINSON.

CHESTNUT-COLORED GRAY-CROWNED LEUCOSTICTE; SWAINSON'S LEUCOSTICTE.

Linaria (Leucosticte) tephrocotis, SWAINS., Faun. Bor.-Am., II, Birds, 1831, 265, pl. 50.

Leucosticte tephrocotis, SWAINS., Birds, II, 1837, 281.—BONAP., Consp., 1850, 536.—BAIRD, Stansbury's Salt Lake, 1852, 317; Birds N. Am., 1858, 430.—COOPER, Orn. Cal., I, 1870, 164.—BAIRD, BREWER, & RIDGWAY, Hist. N. Am. Birds, I, 1874, 504, pl. xxiii, fig. 8.—GRAY, Hand-List, II, 110.—COUES, Key to N. Am. Birds, 1872, 130; B. N. W., 1875, 111 (excl. syn.).

Erythrospiza tephrocotis, BONAP., Comp. List, 1838, 34.—AUD., Synop., 1839; Birds Am., III, 1841, 176, pl. cxcviii.

Fringilla tephrocotis, AUD., Orn. Biog., V, 1839, 232, pl. ccccxxiv.
Montifringilla tephrocotis, BONAP. & SCHLEG., Mon. Loxiens, 1850, 37, pl. 43.

Hab.—Saskatchewan (May, RICHARDSON); Rocky Mountain region of United States in winter (various localities in El Paso County, Colorado, in February, March, and April; AIKEN and Mrs. MAXWELL;—Salt Lake City, Utah, March; Capt. STANSBURY;—Fort Laramie and Deer Creek, Wyoming, November 21, March 7; Dr. HAYDEN.)

SP. CH.—Gray of the head confined to the lateral and posterior portions of the pileum (as in *L. atrata*); sexes exactly alike; general color chocolate-brown. Wing, 3.80–4.40 (4.11); tail, 2.75–3.30 (3.00);* culmen, .40–.50 (.46); tarsus, .75–.86 (.79); middle toe, .50–.65 (.57).†

Male: General color deep chocolate-brown, with a rufous cast, deepest on the throat, and paler on the dorsal region, where the feathers have darker shaft-streaks and appreciably lighter edges. Red of the abdomen confined to the posterior portion near the anal region and the hinder

* Measurements of 155 specimens. † Measurements of 116 specimens.

flanks. Wing, 4.00–4.40 (4.21); tail, 3.10–3.30 (3.12); culmen, .45–.50 (.45); tarsus, .75–.85 (.79); middle toe, .52–.60 (.59).

Female: Colors exactly the same. Wing, 3.90–4.30 (4.16); tail, 2.75–3.15 (3.12); culmen, .42–.50 (.46); tarsus, .75–.85 (.79); middle toe, .55–.60 (.58).

Young, Not seen!

Of the one hundred and fifty-five specimens examined, thirty-five are in the spring-plumage, with uniform black, or dusky, bill, uniform brown, and heightened tint of the red markings.

To represent the var. *tephrocotis* in its purity, I have excluded from it all specimens having even a trace of gray below the lores, or the upper outline of the auriculars. Such specimens correspond to *campestris*, BAIRD (Cooper, Orn. Cal., I, 1870, 163); but, as they are variously intermediate between the present race and var. *littoralis*, I refer them to the latter, and notice them individually under the head of that form.

The spring-plumage of this race is represented in the series before me by thirty-five specimens, which show that there is no constant sexual difference in coloration, many females being as brightly colored as the brightest males, and *vice versa*. In fact, the variations in plumage, other than seasonal, noticeable in the entire series of one hundred and seventy adult examples, seem to be merely individual. There is a greater range of variation in the winter-plumage, but it is only in the shades of coloration, there never being any departure from the characteristic pattern. In some of the more dully-colored individuals, the gray of the crown has more or less of a smoky tinge, sometimes almost uniting the dusky of the forehead with the brown of the neck; while, in others, the gray feathers have smoky-brown shafts or tips. These I consider to be young birds in their first winter-plumage.

List of specimens.

Catalogue-number.	Sex.	Museum.	Locality.	Dates	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
19254	♂	United States	Nebraska	Feb. 23	4.30	3.30	.45	.75	.60	Yellow.
19255	"	do	do	Feb. 22	4.35	3.15	.45	.75	.60	Do.
19257	"	do	do	Feb. 23	4.10	3.00	.45	.80	.60	Clouded.
19271	"	do	do	Feb. 22	4.40	3.30	.50	.80	.60	Yellowish.
66630	"	do	Colorado	Mch. —	4.10	2.95	.48	.75	.52	Clouded.
66631	"	do	do	Mch. —	4.05	3.05	.45	.80	.60	Do.
67915	"	M. C. Z*	Wyoming	Nov. 16	4.30	3.25	.45	.80	.60	Yellow.
751	"	C. E. A	do	Mch. 25	4.20	3.05	.45	.75	.58	Clouded.
974	"	do	do	Feb. —	4.15	3.10	.45	.78	.60	Do.
1700	"	do		Feb. 25	4.05	3.00	.45	.75	.60	Yellow.
1701	"	do	Wyoming	Mch. —	4.00	2.90	.45	.75	.55	
1711	"	do		Feb. 20	4.15	3.10	.45	.80	.55	Yellow.
1735	"	do	Wyoming	Mch. —	4.40	3.20	.45	.80	.60	Do.
1737	"	do	Colorado	Mch. 3	4.25	3.10	.45	.80	.58	
1741	"	do			4.25	3.10	.48	.75	.58	
1742	"	do		Mch. 3	4.00	2.90	.45	.80	.58	
1745	"	do	Colorado	Feb. 28	4.40	3.30	.45	.80	.58	Yellow.
1758	"	do	do	Mch. 3	4.30	3.20	.45	.80	.60	
1760	"	do	do	Mch. 3	4.30	3.25	.45	.85	.55	Clouded.
1771	"	do	do	Feb. 28	4.25	3.15	.45	.80	.60	
	"	M. A. M†	do		4.00	3.15	.50	.80	.55	
	"	do	do		4.30	3.10				
	"	do	do		4.30	3.15				
17610	♀	United States	Bitter-Root Valley		4.20	3.10	.45	.80	.60	
19265	"	do	Nebraska	Feb. 28	4.20	3.00		.80	.50	Clouded; culmen blackish.
19272	"	do	do	Nov. 21	4.30	3.10	.50	.80	.60	
59908	"	do	Wyoming (Gilmer)		4.10	2.90	.45	.80	.55	
60896	"	do	Wyoming	Mch. 1	4.00	2.80	.45	.80	.60	Yellow.
66096	"	do	Wyoming (Sherman).	Mch. —	4.10	2.90	.48	.75	.60	

* Museum of Comparative Zoölogy, Cambridge, Mass.
† Museum of Mrs. M. A. Maxwell, Boulder, Col.

List of specimens—Continued.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
17916	♀	M. C. Z	Wyoming (Percy)	Nov. 16	4.05	3.10	.48	.80	.60	Yellow.
900	"	C. E. A	Wyoming	Nov. —	4.10	3.05	.45	.80	.60	Clouded.
987	"	do	do		4.05	2.90	.45	.80	.58	Yellow.
1690	"	do		Nov. 20	4.00	2.85	.50	.80	.55	
1692	"	do	Colorado	Feb. 20	4.00	2.95	.45	.80	.60	Yellow.
1698	"	do	do	Feb. 20	4.10	3.15	.45	.85	.60	Do.
1703	"	do	do	Feb. 20	3.95	2.80	.50	.82	.55	Do.
1704	"	do	do	Mch. 20	4.00	2.80	.48	.80	.60	Clouded.
1714	"	do	do	Feb. 20	4.15	3.00	.45	.85	.60	Yellow.
1715	"	do	do	Mch. 3	4.00	2.90	.45	.75	.58	Do.
1716	"	do	do	Mch. 20	4.00	3.00	.45	.82	.55	Clouded.
1717	"	do	do	Feb. 20	4.10	3.00	.45	.82	.55	
1725	"	do	do	Mch. 20	3.90	2.85	.42	.75	.55	Yellow.
1730	"	do	do	Mch. 3	3.90	2.75	.52	.80	.55	Clouded and deformed.
1736	"	do	do	Mch. 3	4.15	3.00	.50	.80	.55	Clouded.
1738	"	do	do	Mch. 20	4.20	3.10	.42	.75	.58	Do.
1739	"	do	do	Mch. 3	4.10	3.10	.45	.80	.60	Do.
1747	"	do	do	Mch. 3	4.00	2.80	.45	.80	.60	Do.
1748	"	do	do	Mch. 3	4.10	2.90	.45	.80	.60	Do.
1757	"	do	do	Mch. 3	3.95	2.90	.45	.80	.58	Do.
1761	"	do	do	Mch. 3	3.95	2.90	.45	.75	.60	Do.
1762	"	do	Wyoming (Sherman).	Mch. —	3.95	2.85	.40	.75	.55	Do.
1766	"	do	Colorado	Mch. —	4.20	3.00	.50	.80	.60	
1772	"	do	do	Feb. 28	4.10	3.10	.45	.80	.60	Yellow.
1848	"	do	do		3.90	2.80	.45	.80	.60	
	"	M. A. M	do		3.95	2.80	.45	.80	.55	Black.
	"	do	do		3.90	2.85	.45	.80	.60	Do.
	"	do	do		4.10	3.00	....	....	....	
3701	....	United States	Utah	Mch. 21	4.35	3.00	.45	.80	.60	
	....	do	Colorado	Dec. —	4.15	3.00	.48	.80	.55	
32292	....	do	Wyoming (Ft. Laramie).	Dec. 28	4.05	3.00	.49	.75	.60	
59910	....	do	Wyoming	Feb. 26	4.30	3.10	.48	.75	.60	
699	....	C. E. A	do	Mch. —	4.10	2.90	.45	.75	.58	
1299	....	do	do		4.10	3.00	.48	.80	.55	Black.
1521	....	do	do		4.10	3.00	.45	.80	.55	
1535	....	do	do		4.20	3.10	.48	.75	.60	Black.
1539	....	do	do		4.00	2.80	.45	.80	.55	Do.
1591	....	do	do		4.20	2.90	.45	.85	.60	Do.
1600	....	do	Colorado		4.10	2.80	.50	.85	.60	Do.
1611	....	do			4.00	3.00	.45	.78	.60	Do.
1622	....	do	Colorado		4.00	3.00	.45	.75	.58	Do.
1625	....	do	do		4.05	3.05	.45	.80	.60	Do.
1638	....	do	do		4.30	3.10	.45	.80	.60	Do.
1640	....	do	do		4.05	2.95	.45	.75	.55	Do.
1724	....	do	do		4.00	3.00	.45	.80	.58	Clouded.
1739	....	do	do		4.30	3.10	.45	.85	.65	Black.
1740	....	do	do		4.00	3.00	.48	.80	.60	Do.
1750	....	do	do		4.25	3.10	.45	.75	.60	Do.
1753	....	do	do	Mch. 3	4.15	3.00	.45	.80	.58	Clouded.
1755	....	do	do		4.05	2.90	.45	.80	.60	Black.
1775	....	do	do		4.00	3.15	.45	.80	.60	Do.
1780	....	do	do		4.20	3.10	.45	.75	.60	Do.
1786	....	do	do		4.00	2.90	.45	.80	.55	Do.
1787	....	do	do		4.10	3.00	.45	.80	.60	Do.
1797	....	do	do		4.10	3.15	.45	.75	.58	Do.
1799	....	do	do		4.10	3.10	.45	.80	.60	Do.
1800	....	do	do		3.80	2.80	.45	.75	.55	Do.
1803	....	do	do		4.20	3.00	.45	.85	.60	Do.
1811	....	do	do		4.05	2.85	.45	.80	.58	Do.
1813	....	do	do		3.95	2.80	.45	.75	.60	Do.
1825	....	do	do		4.05	3.10	.45	.85	.60	Do.
1827	....	do	do		4.05	3.10	.45	.80	.60	Do.
1830	....	do	do		4.10	3.00	.45	.85	.60	Do.
1837	....	do	do		4.15	2.90	.45	.80	.60	Do.
1840	....	do	do		4.00	3.00	.45	.85	.60	Do.
1842	....	do	do		4.10	3.00	.45	.80	.55	Do.
1846	....	do	do		4.25	3.10	.45	.80	.60	Do.
1850	....	do	do		4.10	3.00	.45	.75	.60	Do.
1855	....	do	do		4.10	3.10	.45	.86	.60	Do.
1858	....	do	do		4.05	3.10	.45	.80	.60	Do.
1859	....	do	do		4.10	2.90	.45	.80	.60	Do.
1865	....	do	do		4.05	3.00	.45	.75	.55	Do.
	....	M. A. M	Wyoming		4.10	2.80	.40	.80	.58	Dusky.
	....	do	do		4.10	2.80	.45	.80	.55	Do.

List of specimens—Continued.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
	....	M. A. M.	Wyoming	....	4.10	2.90	.45	.80	.60	Yellow.
	....	do	do	....	4.00	2.90	.45	.80	.55	Clouded.
	....	do	do	....	4.35	3.10	.48	.85	.65	Do.
	....	do	do	....	4.10	2.90	.50	.80	.60	Do.
	....	do	do	....	3.95	2.80	.45	.80	.60	Do.
	....	do	Colorado	....	4.00	3.05	.45	.80	.58	
	....	do	do	....	4.00	2.90	.45	.80	.60	
	....	do	do	....	4.10	3.20	.45	.80	.55	
	....	do	do	....	4.10	3.00	.45	.80	.55	
	....	do	do	....	4.10	3.00	.45	.80	.60	
	....	do	do	....	4.20	3.00	.45	.80	.60	
	....	do	do	....	4.10	3.00	.45	.80	.58	
	....	do	do	....	4.00	3.10	.45	.80	.60	
	....	do	do	....	3.90	2.75	.45	.75	.60	Black.
	....	do	do	....	4.15	3.00	....	....	....	
	....	do	do	....	4.40	3.20	....	....	....	
	....	do	do	....	4.25	3.10	....	....	....	
	....	do	do	....	4.20	3.05	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
	....	do	do	....	4.20	2.90	....	....	....	
	....	do	do	....	4.00	2.90	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
	....	do	do	....	4.30	3.15	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
	....	do	do	....	4.20	3.15	....	....	....	
	....	do	do	....	4.00	3.00	....	....	....	
	....	do	do	....	4.20	3.10	....	....	....	
	....	do	do	....	4.00	3.00	....	....	....	
	....	do	do	....	4.00	2.90	....	....	....	
	....	do	do	....	4.20	2.95	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
	....	do	do	....	4.20	3.15	....	....	....	
	....	do	do	....	4.20	3.00	....	....	....	
	....	do	do	....	4.10	2.90	....	....	....	
	....	do	do	....	4.10	2.90	....	....	....	
	....	do	do	....	4.00	2.90	....	....	....	
	....	do	do	....	4.00	3.00	....	....	....	
	....	do	do	....	4.20	3.00	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
	....	do	do	....	4.05	2.90	....	....	....	
	....	do	do	....	4.10	2.90	....	....	....	
	....	do	do	....	4.30	3.10	....	....	....	
	....	do	do	....	4.00	2.90	....	....	....	
	....	do	do	....	4.05	2.90	....	....	....	
	....	do	do	....	4.10	2.90	....	....	....	
	....	do	do	....	4.20	3.10	....	....	....	
	....	do	do	....	4.00	3.00	....	....	....	
	....	do	do	....	4.15	3.00	....	....	....	
	....	do	do	....	4.25	3.20	....	....	....	
	....	do	do	....	4.10	3.00	....	....	....	
377	...	R. R.*	Wyoming	Feb. —	4.25	3.20	.48	.82	.60	

LEUCOSTICTE TEPHROCOTIS, SWAINSON, VAR. LITTORALIS, BAIRD.

HEPBURN'S LEUCOSTICTE.

"*Leucosticte griseinucha*, BRANDT," ELLIOT, Illust. Birds Am., X.

Leucosticte littoralis, BAIRD, Tr. Chicago Ac. Sc., I, ii, 1869, 318, pl. xxviii, f. 1.—DALL and BANNISTER, ib., 282.—BAIRD (COOPER) Orn. Cal., I, 1870, 162.

Leucosticte tephrocotis var. *littoralis*, COUES, Key to N. Am. Birds, 1872, 130.—BAIRD, BREWER, & RIDGWAY, Hist. N. Am. Birds, I, 1874, 507, pl. xxiii, fig. 6.

Leucosticte campestris, BAIRD, Orn. Cal. (COOPER'S), I, 1870, 163.

Leucosticte tephrocotis var. *campestris*, BAIRD, BREWER, & RIDGWAY, Hist. N. Am. Birds, I, 1874, 507, pl. xxiii, fig. 7.

Leucosticte tephrocotis b. *griseinucha*, COUES, B. N. W., 1875, 111 (part).

Hab.—Northwestern regions of North America, migrating southward

* Museum of R. Ridgway.

and south-eastward in winter (Kadiak, Alaska, February 24, BISCHOFF; Sitka, Alaska, January, BISCHOFF; Fort Simpson, British Columbia, HEPBURN; Lake Tahoe, Sierra Nevada, winter, *fide* COOPER; Virginia City, Nevada, January 5, RIDGWAY; Camp Harney, Oregon, December–February, Captain BENDIRE; Fort Saunders, Wyoming, February–March, A. G. BRACKETT; Gilmer, Wyoming, February, H. R. DURKEE; Colorado, January 4–April 18, AIKEN and Mrs. MAXWELL.

SP. CH.—*Adult:* Entire head except the forehead and throat (and sometimes also the throat) gray; sexes exactly alike. Wing, 3.80–4.30 (4.03); tail, 2.70–3.30 (2.95); culmen, .40–.50 (.46); tarsus .75–.85 (.77); middle toe, .50–.62 (.59).*

Male: General color usually deep reddish-chocolate, but varying to rufous-umber and chestnut; throat usually gray and black mixed, rarely uniformly either. Wing, 3.90–4.30 (4.03); tail, 2.70–3.15 (2.95); culmen, .45–.50 (.47); tarsus, .75–.82 (.79); middle toe, .55–.60 (.59).†

Female: Colors similar to those of the male. Wing, 3.95–4.10 (4.07); tail, 2.70–3.10 (2.98); culmen, .45–.50 (.47); tarsus, .75–.85 (.79); middle toe, .55–.60 (.59).†

Young, Not seen!

In the winter-season, the bill is yellow, black-tipped, until about the latter part of February or the beginning of March, when it begins to be stained or clouded with dusky; in April, it is uniform dusky, with a horny shade on the lower mandible, and by May has become deep black.

Corresponding with the darkening of the bill is a heightening of the tint of the red markings, which, from peach-blossom pink in winter, become soft dilute carmine in spring and deeper carmine in summer; in the same degree, the brown feathers lose the pale margins characteristic of the winter-plumage.

In regard to the two sexes, as compared to one another, there is the same absolute similarity in appearance and size that exists in *griseinucha* and *tephrocotis;* many females being more brightly colored, and some larger, than some males. The apparently larger average of the dimensions of the female indicated in the above measurements is no doubt due to the small number of specimens of the sex examined.

In its most extreme form, this race has the entire head gray, except the usual black patch on the forehead; and even this is occasionally nearly obsolete. The average style, however, has the frontal black patch well defined and conspicuous, and the throat about equally clouded with gray and black.

In true *littoralis*, there is no admixture of brown feathers in the cheeks or auriculars, all such specimens being of the "*campestris*" ‡ style—a condition intermediate between *littoralis* and *tephrocotis*, and unstable as a race from the fact that scarcely two specimens are alike. Only eleven of the fifty-four specimens are of this latter character, forty-three being typical representatives of pure *littoralis*. Of these, only eight examples have the throat destitute of any admixture of gray; the throat is entirely gray in two of them, the remainder having the gray and black of proportionate amount varying according to the individual.

The series of aberrant individuals representing the transition to *tephrocotis* is composed of eleven specimens, eight of which are marked as follows: No. 41527, Nat. Mus., Denver, Colorado, January, Dr. Wernigk;

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* Measurements of 48 specimens. † Measurements of 7 specimens. ‡ See synonomy of var. *littoralis*.

type of *campestris*, Baird!:—Throat wholly dark brown; posterior half of auriculars light chocolate-brown; anterior half of auriculars, and anterior border of the chin, the orbital region, and lateral and posterior portions of the pileum gray. No. 1806, Mus. C. E. Aiken, Colorado Springs, Colorado: On one side of the head, the entire auricular region is gray, while on the other side the brown of the maxilla reaches up half-way to the upper edge of the auriculars; the lores and orbits are both gray. No. 1756, Mus. C. E. Aiken, Colorado Springs, February 28: Both auriculars gray; the maxillæ about half-gray; left cheek with two or three brown feathers interspersed; throat wholly chestnut-brown. No. 1769, ♀, Mus. C. E. Aiken, Colorado Springs, March 3: Both cheeks mixed gray and brown. Nos. 1718 and 1721, Mus. C. E. A., are similar to the last, but the latter has one cheek mostly gray, and the other chiefly brown. No. 19254, ♂, Nat. Mus., Deer Creek, Nebraska, February 23: Like typical *tephrocotis*, but lores and orbits silvery gray. A specimen belonging to Mrs. Maxwell has one cheek gray and the other brown.

List of specimens.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
637	♂	C. E. A.	Colorado	Mar. 10	3.90	2.70	.45	.80	.60	Black.
1720	"	....do....	....do	Apl. 18	4.10	3.00	.45	.80	.55	Do.
1756	"	....do....	....do	Feb. 28	4.30	3.20	.50	.82	.60	Clouded.
1763	"	....do....	....do	Feb. 28	4.20	3.15	.45	.80	.60	Do.
1764	"	....do....	....do	Jan. 4	4.00	3.00	.45	.80	.60	Bright yellow.
66632	"	U. S.	....do	Mar —	3.95	2.90	.45	.75	.55	Yellow.
374	"	R. R.	Alaska (Kadiak)	Feb. 24	4.15	2.90	.48	.75	.60	Do.
45976	♀	U. S.	Alaska (Sitka)	Jan —	4.05	3.00	.50	.85	.60	Do.
1691	"	C. E. A.	Colorado	Feb. 28	4.00	3.00	.45	.80	.60	Do.
1705	"	....do....	....do	Feb. 28	4.20	3.05	.45	.80	.60	Do.
1706	"	....do....	....do	Mar. 3	4.00	2.90	.45	.78	.58	Clouded.
1734	"	....do....	....do	Mar. 3	4.00	2.90	.45	.75	.55	Do.
1769	"	....do....	....do	Mar. 3	4.10	3.10	.48	.80	.60	Do.
1770	"	....do....	....do	Mar. 3	3.95	2.90	.48	.80	.60	Do.
*41527	....	U. S.	Colorado, (Denver)	Jan. —	......	......	......	......	......	Yellow.
58097	....	....do....	Alaska (Kadiak)	Feb. 24	4.20	3.00	.45	.80	.60	Do.
59906	...	....do....	Wyoming (Gilmer)	Feb. —	3.90	2.80	.45	.75	.58	Do.
†51131	....	....do....	Br. Col. (Ft. Simpson)	....	4.30	3.30	.45	.80	......	Do.
1601	....	C. E. A.	Colorado	....	3.90	2.80	.45	.78	.60	Black.
1604	....	....do....	... do	....	4.05	3.00	.45	.75	.58	Do.
1607	....	....do....	....do	....	4.00	2.90	.45	.80	.60	Do.
1608	....	....do....	....do	....	4.00	2.90	.45	.85	.60	Do.
1610	....	....do....	....do	....	3.95	2.90	.45	.80	.60	Do.
1617	....	....do....	....do	....	4.00	3.00	.45	.80	.60	Do.
1619	....	....do....	....do	....	3.90	2.85	.45	.80	.55	
1626	....	....do....	....do	....	3.95	2.90	.45	.75	.60	
1627	....	....do....	....do	....	4.00	3.00	.45	.85	.60	
1631	....	....do....	....do	....	4.00	2.90	.45	.80	.60	
1637	....	....do....	....do	....	3.90	2.80	.45	.80	.55	
1645	....	....do....	....do	....	3.80	2.80	.40	.80	.55	
1651	....	....do....	....do	....	4.10	2.85	.45	.80	.60	
1652	....	....do....	....do	....	4.00	2.95	.45	.85	.62	
1693	....	....do....	....do	....	3.80	2.70	.45	.75	.60	
1713	....	....do....	....do	....	4.15	2.95	.48	.80	.55	Black.
1718	....	....do....	....do	....	4.00	3.10	.45	.82	.60	Do.
1721	....	....do....	....do	....	3.95	2.90	.45	.80	.60	Do.
1722	....	....do....	... do	....	4.00	2.80	.45	.80	.60	Do.
1787	....	....do....	....do	....	4.00	3.05	.45	.80	.60	Do.
1793	....	....do....	....do	....	3.95	3.00	.45	.80	.60	Do.
1801	....	....do....	....do	....	4.00	2.90	.45	.80	.58	Do.
1802	....	....do....	....do	....	4.30	3.10	.48	.85	.60	Do.
1806	....	....do....	....do	....	4.30	3.10	.48	.85	.60	Do.
1832	....	....do....	....do	....	4.05	2.85	.46	.80	.60	Do.
1863	....	....do....	....do	....	3.95	2.80	.45	.75	.60	Do.
1866	....	....do....	....do	....	4.10	3.10	.45	.80	.50	Do.
	....	M. A. M.	....do	....	4.05	3.00	.45	.75	.60	Yellow.
	....	....do....	....do	....	4.00	2.90	.45	.75	.60	Do.
377	....	R. R.	Wyoming (Gilmer)	Feb. —	4.00	2.90	.50	.75	.58	Do.

* Type of *L. campestris*, BAIRD. † Type of *L. littoralis*, BAIRD.

LEUCOSTICTE (TEPHROCOTIS, SWAINSON, VAR.?) GRISEINUCHA, BRANDT.

BRANDT'S LEUCOSTICTE.

Passer arctous, var. γ, PALLAS, Zoög. Rosso-Asiat., II, 1831, 23.

Fringilla (Linaria) griseinucha, BRANDT, Bull. Ac. St. Petersburg, Nov., 1841, 36.

Montifringilla (Leucosticte) griseinucha, BONAP. & SCHLEG., Mon. Loxiens, 1850, p. 35, pl. xli.

Leucosticte griseinucha, BONAP., Consp., I, 1850, 537.—BAIRD, B. N. Am., 1858, 430.—KITTLITZ, Denkwürdigkeiten, 1858, I, 291.—DALL & BANNIST., Tr. Chicago Ac. Sc., I, 1869, 282.—BAIRD, ib., 317, pl. xxviii, f. 2.—ELLIOTT, Illust. Birds Am., pl. xi.—BAIRD Orn. Cal., (COOPER), I, 1870, 161.—DALL, Pr. Cal. Acad. Sc., Feb. 8, 1873, 3 (advance paper); id., March 14, 1874, 4 (advance paper).

Leucosticte tephrocotis var. *griseinucha*, COUES, Key to N. Am. Birds, 1872, p. 130.—BAIRD, BREWER, & RIDGW., Hist. N. Am. Birds, I, 1874, 508, pl. xxiii, fig. 5.

Leucosticte tephrocotis griseinucha, COUES, B. N. W., 1875, 111 (part).

Leucosticte griseogenys, GOULD, P. Z. S., 1843, p. 104.

Hab.—Aleutian Islands and coast of Alaska from Kadiak northward (Iliulink, Amaknak, November, DALL; Saint Paul's and Saint George's, May 7–July 10, ELLIOTT; Kadiak, November 18–February 2, BISCHOFF; Unalashka, July 10, DALL).

SP. CH.—*Adult:* Entire head, except the forehead and throat (the throat never!), gray. Sexes exactly alike. Wing, 4.20–4.85 (4.49); tail, 3.15–3.90 (3.49); culmen, .50–.62 (.57); tarsus, .85–1.00 (.95); middle toe, .65–.75 (.71).*

Male: General color dark sepia or chocolate, becoming black on the throat and with a deep chestnut cast on the breast and back. Wing, 4.25–4.75 (4.48); tail, 3.25–3.80 (3.49); culmen, .50–.62 (.57); tarsus, .85–1.00 (.98); middle toe, .65–.75 (.70).†

Female: Colors precisely similar. Wing, 4.20–4.85 (4.48); tail, 3.15–3.90 (3.49); culmen, .55–.60 (.56); tarsus, .90–1.00 (.95); middle toe, .70–.75 (.73).‡

Young: Prevailing color uniform brownish gray, washed with umber; wings and tail dusky slate, the feathers bordered with paler; the edges of the lesser wing-coverts and remiges very pale pinkish; of the greater wing-coverts and tertials pale dull ochraceous. No black or gray about the head. Bill horn-color.

Precisely the same seasonal changes take place in this race that obtain in the other forms. The series in breeding-plumage is very large, consisting of thirty-eight specimens, obtained with many nests and eggs and a number of young birds, on the fur-seal islands (Saint George's and Saint Paul's) of the Aleutian Archipelago, by Mr. H. W. Elliott, the talented artist and accomplished collector stationed there in the interest of the United States Government.

In the entire series of fifty-two adult specimens not one has any gray on the throat—almost always present in var. *littoralis*; indeed, no other form of the genus is so uniform in characters or presents so small a range of individual variation as the present one. So uniform are its characters that we are tempted to rank this form as a distinct species;

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* Measurements of 46 specimens.

† Measurements of 27 specimens.

‡ Measurements of 13 specimens.

and it is only in view of its close resemblance in pattern of coloration to *tephrocotis* var. *littoralis*, the corresponding connection of their habitats, and the correlation of their difference in size to a recognized law of latitudinal variation, that we are induced to subordinate its rank. We must frankly state, however, that we have yet to see a specimen which is really intermediate between the two forms, while, if they were not distinct, such should occur in the very large collections of the two which have been examined. This, taken in connection with the fact that typical examples of the two were taken together at the same time (Kadiak, February—BISCHOFF), is almost sufficient to justify their separation specifically, which will have to be done in case connecting specimens do not eventually turn up.

List of specimens.

Catalogue-number.	Sex.	Museum.	Locality (Alaska)	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
61627	♂	U. States	Ilinlink........	Nov. 27	4.50	3.50	.50	.95	.68	Deep yellow.
61628	"	....do....	Amaknak	Nov. 26	4.40	3.40	.55	.88	.70	Do.
62394	"	....do....	Saint Paul's ...	May 17	4.40	3.40	.55	.95	.70	Black.
62396	"	....do....	....do..........	May 7	4.70	3.75	.60	1.00	.70	Do.
64152	"	....do....	Saint George's.	June 15	4.70	3.50	.60	.95	.75	Black, tinged with orange.
64155	"	....do....	....do..........	June 13	4.75	3.80	.60	.95	.70	Black.
64160	"	....do....	....do..........	June 13	4.55	3.60	.60	1.00	.70	Do.
64162	"	....do....	....do..........	June 13	4.35	3.30	.62	.98	.65	Do.
64165	"	....do....	....do..........	June 13	4.50	......	.50	.95	.70	Do.
64171	"	....do....	....do..........	June 13	4.50	......	.55	.95	.65	Do.
64172	"	....do....	....do..........	June 13	4.60	3.60	.60	.95	.70	Do.
64173	"	....do....	....do..........	June 15	4.30	......	.55	.90	.72	Do.
64175	"	....do....	....do..........	June 15	4.40	3.40	.55	1.00	.70	Black, tinged with orange.
64176	"	....do....	....do..........	June 13	4.60	3.40	.60	.95	.72	Black.
64177	"	....do....	....do..........	June 15	4.40	......	.55	.95	.70	Do.
64178	"	....do....	....do..........	June 13	4.50	3.40	.60	.95	.70	Do.
64179	"	....do....	Saint Paul's ...	June 13	4.40	3.25	.55	.90	.70	Black, tinged with orange.
64180	"	....do....	....do..........	June 15	4.25	3.30	.55	.92	.70	Do.
64182	"	....do....	....do..........	June 13	4.30	......	.55	.90	.75	Black.
64183	"	....do....	....do..........	June 15	4.40	3.40	.55	1.00	.70	Do.
64184	"	....do....	....do..........	June 12	4.40	......	.55	.92	.70	Do.
64185	"	....do....	....do..........	June 13	4.60	3.75	.55	1.00	.75	Do.
64188	"	....do....	....do..........	June 13	4.30	3.40	.58	.90	.70	Do.
64189	"	....do....	....do..........	June 15	4.35	3.40	.60	.95	.70	Do.
64191	"	....do....	....do..........	June 13	4.40	......	.55	.95	.70	Do.
373	"	R. R......	Kadiak........	Feb. 4	4.70	3.55	.55	.85	.68	Yellow.
1906	"	....do....	Saint George's.	July 10	4.70	3.75	.60	1.00	.70	Black.
62395	♀	U. S	....do..........	July 5	4.40	3.45	.55	.90	.70	Do.
62402	"	....do....	....do..........	July 10	4.60	3.50	.55	1.00	.75	Do.
64153	"	....do....	....do..........	June 9	4.70	3.50	.60	.95	.75	Do.
64154	"	....do....	....do..........	June 13	4.20	3.15	.55	.95	.70	Do.
64157	"	....do....	....do..........	June 13	4.40	......	.60	.95	.75	Do.
64158	"	....do....	....do..........	June 12	4.40	......	.55	.95	.70	Do.
64159	"	....do....	....do..........	June 12	4.40	3.50	.55	.95	.70	Do.
64163	"	....do....	....do..........	June 6	4.80	3.90	.55	1.00	.75	Do.
64166	"	....do....	....do..........	June 13	4.30	......	.55	.95	.70	Do.
64167	"	....do....	....do..........	June 13	4.50	3.40	.55	.95	.75	Do.
64168	"	....do....	....do..........	June 13	4.30	3.30	.55	.95	.70	Do.
64169	"	....do....	....do..........	June 15	4.80	3.70	.55	.90	.75	Do.
64190	"	....do....	....do..........	June 13	4.40	3.40	.58	.95	.73	Do.
58083	....	....do....	Kadiak........	Feb. 2	4.60	3.60	.50	.85	.65	Yellow.
58087	....	....do....	....do..........	Nov. 18	4.30	3.20	.52	.95	.60	Do.
54243	....	....do....	Unalashka.....	July 10	4.50	3.30	.55	.95	.70	Horn-yellow-clouded.
64164	....	....do....	Saint George's.	June 11	4.85	3.80	.58	.95	.70	Black.
64174	....	....do....	....do..........	June —	4.50	3.45	.60	.95	.70	Do.
64187	....	....do....	....do..........	June —	4.50	3.50	.55	1.00	.70	Do.
64191	....	....do....	....do..........	June —	4.40	......	.55	.95	.70	Do.

LEUCOSTICTE AUSTRALIS (ALLEN).

BROWN-CAPPED LEUCOSTICTE; ALLEN'S LEUCOSTICTE.

? ? *Passer arctoa*, β, 2, PALLAS, Zoög. Rosso-As., II, 1831, 22.

'*Leucosticte griseinucha*," ALLEN, Am. Nat., VI, No. 6, June, 1872, p. 350.

" *Leucosticte tephrocotis*," ALLEN, "Ornithological Notes from the West" (reprint of article in Am. Nat.), 1872, 22; Bull. Mus. Comp. Zoöl., Cambridge, III, No. 6, p. 177.—BAIRD, BREWER, & RIDGWAY, Hist. N. Am. Birds, I, 1874, pp. 504–505 (foot-note), pl. xxiii, f. 9.—COUES, B. N. W., 1875, 111 (see foot-note).

Leucosticte tephrocotis var. *australis*, ALLEN, MSS.—RIDGWAY, Bull. Essex Inst., V, November, 1873, pp. 182, 189, 190.—BAIRD, BREWER, & RIDGWAY, Hist. N. Am. Birds, III, app., p. 509.

Hab.—Colorado and New Mexico (Mount Lincoln, Colorado; altitude, 12,000 feet), July, ALLEN; Pike's Peak, HAYDEN; South Park, Mount Evans, Mount Harvard, Red Mountains and neighborhood, WHEELER (ROTHROCK); New Mexico, WHEELER.

SP. CH.—No gray on the head; sexes very dissimilar. Wing, 4.00–4.40 (4.15); tail, 2.80–3.35 (3.09);* culmen, .40–.48 (.45); tarsus, .70–.80 (.77); middle toe, .55–.60 (.57).†

Adult male: General color light chocolate-brown, of a raw-umber cast, deepest on the throat, which usually inclines toward maroon-purple or claret-brown, and is sometimes tinged with carmine; the dorsal feathers with appreciably paler edges and darker shaft-streaks. Pileum grayish dusky, becoming gradually dull black on the forehead, and more grayish (but not approaching ash) laterally. Red of the abdomen extended forward to the breast—sometimes minutely tipping every feather of the throat, jugulum and fore-neck. Wing, 4.00–4.40 (4.30); tail, 2.80–3.35 (310);‡ culmen, .40–.48 (.45); tarsus, .70–.80 (.77); middle toe, .55–.60 (.58).§

Adult female: Prevailing color pale grayish raw-umber, the pileum hardly appreciably different, and the forehead scarcely inclining to black; red markings almost obsolete, and distinctly indicated only on the lesser wing-coverts and rump; greater coverts, remiges, and rectrices skirted with whitish; abdomen scarcely tinged with red. Wing, 4.00–4.25 (4.09);|| tail, 2.90–3.25 (3.03); culmen, .45–.48 (.47); tarsus, .75–.78 (76); middle toe, .55–60 (.57).¶

Young, Not seen!

The male and female differ constantly in the respects pointed out above; the brightest female not approaching the duller males in intensity of the colors or in the precision of the pattern of coloration.

In the spring, both sexes have the bill uniform dusky, the shade varying according to the month; thus, specimens obtained in the latter part of February have the bill yellow; those killed early in March have this color clouded or shaded with horn-dusky; in May, the bill has become uniform dusky horn-color, approaching blackish slate, and in June it

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* Measurements of 104 specimens.
† Measurements of 50 specimens.
‡ Measurements of 69 specimens.
§ Measurements of 46 specimens.
|| Measurements of 28 specimens.
¶ Measurement of 3 specimens; average of measurements of the full series would approximate more closely to that of the male.

has deepened to an intense black color. At this season (from March until the latter part of May), the red is of a peach-blossom-pink tint, only a little deeper in shade than in winter, and the feathers of the pileum have distinctly paler margins.

In mid-summer, when the bill is uniform deep black, the pale margins to the feathers of the crown, the brown or grayish of the plumage becomes more uniform and harsher in consequence of the wearing and exposure of the feathers, while the red of the male is heightened into an intense crimson, or harsh carmine tint. This condition of plumage is characteristic of specimens obtained in the breeding-season (June and July) on Mount Lincoln and adjoining peaks in Colorado by Mr. Allen and Mr. Batty.

In the winter-plumage, the males have not been seen. Two or three females, however, obtained in February and the early part of March, differ from the spring and summer examples of that sex in having the bill yellow, tipped with dusky, and the markings very ill-defined in consequence of paler borders to all the contour-feathers.

In this very distinct species, the brown is decidedly lighter and more tawny than in the races of *L. tephrocotis*, while, unlike that species, there is a conspicuous difference in the coloration of the sexes, a fact substantiated by a series of sixty-nine males and thirty-six females. In the male, the red of the lower parts extends much farther forward than in the other forms, always covering, pretty uniformly, the entire abdomen and sides, while it frequently invades the breast, or even sometimes tinges the throat and cheeks. In both sexes, the pileum is invariably dusky, with a sooty-grayish tinge laterally, becoming insensibly black on the forehead. Compared with the wings, the tail is relatively longer than in the other forms, while the tarsus is, on the average, appreciably shorter. The striking sexual difference exists besides only in *L. atrata*.

In a series of sixty-nine adult males in spring and summer plumage, the characters above assigned to the species are exhibited without the slightest variation from the terms of the diagnosis. Although in all of these specimens the brown of the throat has a more or less perceptible purplish tone, in twenty-seven of them the tips of the feathers are touched with a pure purple or bright red (according to the season, purple in winter and carmine in summer); one (No. 66027, Mount Lincoln, Colorado, July 15; Dr. Hayden—J. H. Batty) has each feather of the whole of the gular and pectoral regions distinctly, though minutely, tipped with carmine; some specimens have even the posterior scapulars tipped with carmine.

The females differ conspicuously from the males, being always much paler and duller in colors, the tints inclining to earthy-grayish and the red very much less distinct—often almost wanting. They vary more also than do the males. The greater number of the thirty-six examples before me have the pinkish markings very faint; many have them almost obsolete, the whole plumage being nearly uniform grayish-brown, relieved only by the darker front and the whitish edges of the wing and tail feathers. The few which show the red distinctly have it very much paler and duller than in the dullest males, while the other colors do not approach those of that sex in richness of shades and sharpness of pattern.

On page 22, vol. II of "*Zoögraphia Rosso-Asiatica*," Pallas describes under the name of "*Passer arctoa*, β, 2," a form which, if not identical, is much like this species. The description is as follows: "β, 2, ibidem Curilica; *Capite* suprai (præter frontem fuscam) cum *cervice* ferruginea, dorso fusco, plumis margine ferrugineScentibus. *Subtus* fusca, roseo,

et versus jugulum albido liturata. *Crissum* totum roseum; uropygii plumæ et tectrices caudæ apice rosae. *Alarum* pennæ et vestrices margine externo roseæ, dorso proximæ gryseo-marginatæ.—In utraque rectrices totæ nigricantes, marginibus albidis." This may also be the *L. brunneinucha*, Brandt.

List of specimens.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Color of bill.
66027	♂	U. S.	Colorado	July 15	4.10	2.90	.48	.70	.58	Black.
66798	"	....do	....do		4.05	2.95				Do.
66799	"	....do	....do		4.15	3.10				Do.
66800	"	....do	....do		4.40	3.15	.40	.80	.60	Do.
15723	"	M. C. Z.	....do	July 25	4.30	3.20	.45	.75	.60	Do.
15724	"	....do	....do	July 25	4.20	3.10	.48	.80	.60	Do.
15725	"	....do	....do	July 25	4.00	2.80	.48	.70	.55	Do.
1389	"	C. E. A.	....do		4.30	3.25	.45	.75	.55	Do.
1507	"	....do	....do		4.20	3.10	.45	.75	.55	Do.
1510	"	....do	....do		4.30	3.25	.45	.80	.60	Do.
1526	"	....do	....do		4.10	3.05	.45	.75	.55	Do.
1588	"	....do	....do		4.30	3.25				Do.
1597	"	....do	....do		4.30	3.20				Do.
1602	"	....do	....do		4.30	3.20	.45	.70	.55	Do.
1603	"	....do	....do		4.15	3.10	.45	.80	.55	Do.
1609	"	....do	....do		4.25	3.30	.45	.72	.55	Do.
1614	"	....do	....do		4.30	3.25				Do.
1616	"	....do	....do		4.00	3.05	.45	.80	.60	Do.
1621	"	....do	....do		4.25	3.10	.40	.80	.58	Do.
1628	"	....do	....do		4.25	3.25				Do.
1632	"	....do	....do		4.30	3.15	.45	.75	.60	Do.
1633	"	....do	....do	May 15	4.20	3.15	.45	.80	.60	Do.
1633*b*	"	....do	....do		4.35	3.20	.45	.75	.55	Do.
1635	"	....do	....do		4.20	3.20	.45	.75	.60	Do.
1639	"	....do	....do		4.30	3.20				Do.
1644	"	....do	....do		4.15	3.10	.45	.70	.55	Do.
1646	"	....do	....do		4.30	3.30	.45	.75	.57	Do.
1650	"	....do	....do		4.40	3.30	.47	.80	.60	Do.
1657	"	....do	....do		4.10	3.10				Do.
1658	"	....do	....do		4.20	3.15	.45	.75	.55	Do.
1696	"	....do	....do		4.30	3.15	.45	.80	.60	Do.
1697	"	....do	....do		4.10	3.15				Do.
1699	"	....do	....do	Mar. 3	4.20	3.10	.45	.78	.55	Clouded.
1702	"	....do	....do		4.30	3.15				Black.
1707	"	....do	....do		4.10	3.00	.45	.72	.55	Do.
1708	"	....do	....do		4.20	3.20	.45	.80	.60	Do.
1710	"	....do	....do		4.20	3.15	.45	.75	.55	Do.
1723	"	....do	....do		4.30	3.15	.45	.80	.60	Do.
1729	"	....do	....do	April 18	4.05	2.90				Do.
1733	"	....do	....do		4.20	3.25				Do.
1739	"	....do	....do		4.20	3.10	.45	.80	.58	Do.
1743	"	....do	....do		4.00	2.90	.40	.80	.60	Do.
1746	"	....do	....do	April 18	4.40	3.20	.45	.80	.55	Do.
1751	"	....do	....do		4.25	3.15	.42	.75	.60	Do.
1752	"	....do	....do		4.20	3.15				Do.
1772	"	....do	....do		4.40	3.20				Do.
1774	"	....do	....do		4.20	3.15	.45	.78	.60	Do.
1779	"	....do	....do		4.30	3.15	.45	.75	.60	Do.
1783	"	....do	....do		4.20	3.10				Do.
1784	"	....do	....do		4.30	3.20	.45	.75	.55	Do.
1785	"	....do	....do		4.15	3.15				Do.
1789	"	....do	....do		4.20	3.00	.42	.80	.55	Do.
1790	"	....do	....do		4.10	3.10				Do.
1791	"	....do	....do		4.10	3.00	.45	.78	.60	Do.
1795	"	....do	....do		4.30	3.30	.45	.80	.55	Do.
1805	"	....do	....do		4.25	3.15				Do.
1807	"	....do	....do		4.40	3.35				Do.
1808	"	....do	....do		4.30	3.20	.45	.80	.55	Do.
1810	"	....do	....do		4.30	3.15	.42	.80	.60	Do.
1812	"	....do	....do		4.20	3.10	.45	.80	.55	Do.
1818	"	....do	....do		4.25	3.15				Do.
1821	"	....do	....do		4.30	3.30	.40	.80	.58	Do.
1822	"	....do	....do		4.20	3.20	.45	.80	.55	Do.
1835	"	....do	....do		4.30	3.30	.45	.75	.55	Do.
1847	"	....do	....do		4.20	3.10	.45	.75	.60	Do.
1861	"	....do	....do		4.30	3.25	.45	.80	.60	Do.
2470	"	R. R.	....do		4.30	3.15	.48	.80	.60	Do.
	"	G. N. L*	....do		4.30	3.15				Do.
66633	♀	U. S.	....do	Mar. —	4.10	3.00	.48	.75	.55	Yellow.

*Museum of George N. Lawrence, esq., New York.

List of specimens—Continued.

Catalogue-number.	Sex.	Museum.	Locality.	Date.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe	Color of bill.
15721	♀	M. C. Z.	Colorado	July 25	4. 05	2. 90	. 48	. 78	. 55	Black.
15722	"	....do	....do	July 25	4. 05	3. 00	. 45	. 75	. 60	Do.
1515	"	C. E. A.	....do	....	4. 10	3. 00	......	......	......	Do.
1595	"	....do	....do	....	4. 10	3. 05	......	......	......	Do.
1599	"	....do	....do	May 15	4. 05	3. 00	......	......	......	Do.
1615	"	....do	....do	....	4. 20	3. 15	......	......	......	Do.
1623	"	....do	....do	....	4. 10	2. 95	......	......	......	Do.
1629	"	....do	....do	....	4. 20	3. 20	......	......	......	Do.
1634	"	....do	....do	....	4. 00	3. 05	......	......	......	Do.
1653	"	....do	....do	....	4. 20	3. 15	......	......	......	Do.
1695	"	....do	....do	....	4. 05	3. 00	......	......	......	Do.
1709	"	....do	....do	....	4. 05	3. 05	......	......	......	Do.
1719	"	....do	....do	....	4. 20	3. 25	......	......	......	Do.
1726	"	....do	....do	....	4. 10	3. 05	......	......	......	Do.
1727	"	....do	....do	....	4. 10	3. 20	......	......	......	Do.
1728	"	....do	....do	....	4. 10	3. 00	......	......	......	Do.
1731	"	....do	....do	....	4. 20	3. 00	......	......	......	Do.
1744	"	....do	....do	....	4. 20	3. 15	......	......	......	Do.
1759	"	....do	....do	March 3	4. 10	3. 00	......	......	......	Clouded.
1768	"	....do	....do	Feb. 20	4. 15	3. 00	......	......	......	Yellow.
1773	"	....do	....do	....	4. 00	3. 00	......	......	......	Black.
1781	"	....do	....do	....	4. 15	3. 20	......	......	......	Do.
1788	"	....do	....do	....	4. 10	3. 05	......	......	......	Do.
1794	"	....do	....do	....	4. 10	3. 10	......	......	......	Do.
1796	"	....do	....do	....	4. 20	3. 10	......	......	......	Do.
1798	"	....do	....do	....	4. 00	3. 05	......	......	......	Do.
1804	"	....do	....do	....	4. 05	3. 00	......	......	......	Do.
1809	"	....do	....do	....	4. 05	3. 05	......	......	......	Do.
1815	"	....do	....do	....	4. 10	3. 10	......	......	......	Do.
1816	"	....do	....do	....	4. 20	3. 15	......	......	......	Do.
1817	"	....do	....do	....	4. 05	2. 90	......	......	......	Do.
1836	"	....do	....do	....	4. 05	3. 00	......	......	......	Do.
1837	"	....do	....do	....	4. 00	3. 00	......	......	......	Do.
1839	"	....do	....do	....	4. 25	3. 25	......	......	......	Do.
1857	"	....do	....do	....	4. 20	3. 15	......	......	......	Do.

THE CRANIAL AND DENTAL CHARACTERS OF GEOMYIDÆ.

By Dr. Elliott Coues, U. S. A.

$$I.\frac{1-1}{1-1};\ C.\frac{0-0}{0-0};\ P.\frac{0-0}{0-0};\ M.\frac{4-4}{4-4};\ =\frac{5-5}{5-5}=\frac{10}{10}=20.$$

The skull and teeth of the two genera, *Geomys* and *Thomomys*, which compose this family, are so similar that they may be described for the most part in identical terms. The generic characters will be pointed out in the sequel; and some of the remarkable peculiarities of the cranium of the most closely allied family, *Saccomyidæ*, will be noted.

In its massiveness and angularity the skull of the *Geomyidæ* differs altogether from that of the *Saccomyidæ*, in which the cranium is singularly papery and bullous, with few angles, and quite closely resembles an arvicoline type. The jaws are remarkably strong; the incisors immense; the zygomata flaring; the occipital region is extensive; the palate proper is contracted and at the same time prolonged downward; there is a long arched interval between molars and incisors. On a plane surface the skull without the lower jaw rests level upon the molars and incisors, no other points touching the support. The molars are all rootless and perennial. The inferior incisors traverse the whole jaw. The superior incisors are semicircular. No anteorbital foramen occupies a usual site. The complex temporal bone is inordinately enlarged in all its elements, but especially the squamosal, which represents most of the cerebral roofing at expense of the reduced parietals. The malar is merely a short splint; there is an osseous tubular meatus auditorius. There are no orbital processes; the interorbital constriction is narrower than the rostrum; the latter is more than a third of the length of the whole skull. Such are some of the general features, from which we may proceed to details—first of configuration of the whole, afterward of characters of individual bones.

Viewed from above, rather less than the posterior two-thirds of the skull presents a subquadrilateral figure, from which the rostrum protrudes in front. The greatest width is opposite the fore part of the zygomata, in most cases, though specimens differ in this respect, owing to a variable curve of these parts. In adult *Geomys*, the case is as stated, the zygomata converging a little backward in a nearly straight line, so that posteriorly their width apart is little if any greater than the intermastoid diameter of the skull. In *Thomomys* there is a more decided outward convexity of these arches, and their greatest width apart is nearly at their middle—if anything posterior to this, and at any rate the width here decidedly surpasses the intermastoid diameter. In front, the zygomatic plates of the maxillaries start out at nearly a right angle with the long axis of the skull; behind, the zygomata curve rather abruptly in to the squamosal. There is a deep abrupt emargination behind the posterior root of the zygomata, between this and the posterolateral corner of the skull; in the recess, the tubular bony meatus auditorius appears protruding in this view. The lambdoidal crest, forming the posterior boundary of the skull, is a slight curve, more or less irregular; most of it is squamosal, for the occipital bone rises to this crest for only a short distance. The narrowest part of the skull is between the orbits, where the width is less than the diameter of the rostrum. The irregularly pyriform figures, circumscribed by the zygomata and

walls of the cranium, are of large size; no orbits proper are defined in the general orbital space, owing to deficiency of both pre- and post-orbital processes. The dome of the cerebral cavity is but little inflated; its sides seem somewhat pinched, there being a decided though shallow concavity just above the zygomatic spur of the squamosal; and a slight bulging anteriorly on each side at the usual site of post-orbital processes. The median line of the cerebral roof, in an old *Geomys* skull, is a ridge; this ridge bifurcates anteriorly to send a curved leg forward and outward to the orbital margins; and behind enlarges a little to receive a small interparietal. In various *Thomomys* skulls of different ages the squamosals leave a rectangular interval occupied by small narrowly linear parietals; and, instead of a single median ridge, there are two parallel ridges with a depressed interval. The sides of the rostrum are straight and parallel, the edge being the swollen track of the superior incisors. The end is vertically truncate, the tips of the nasals and intermaxillaries, and the faces of the incisors being all about in one perpendicular plane. The width of the rostrum is rather more than half its length.

Viewed in profile, the skull shows an almost perfectly straight dorsal outline from the occipital protuberance to a point just in advance of the orbits. Here is the highest point of the skull, whence the profile of the rostrum slopes gently downward, ending abruptly by vertical truncation. Likewise, the posterior or occipital outline is straight, or nearly so, and at a right angle with the superior surface. Likewise, again, the inferior surface of the skull, in all that part lying behind the pterygoids, presents a nearly straight and horizontal profile, at right angles with the occipital plane. Neither bulla ossea nor paroccipital nor condyle is sufficiently developed to interfere with the straightness of outline and rectangularity which all the back part of the skull presents to the side view. The rest of the under outline of the skull consists of the palatal profile as a whole. This consists, anteriorly, of a deep (semi-oval) concavity; there is an abrupt rise from the incisive alveolus, and then a long gradual curve sloping far backward and downward to the molar alveolus; while the strong obliquity of set of the anterior molars protracts this same curve to the tips of the teeth. The molar alveolar border is very short, and rather oblique, being lowest behind. The enormous arched interval between the incisors and molars is highly characteristic, as is also the low position of the molars—the teeth dip below a line drawn from the tips of the incisors to the foramen magnum. Behind the palate, flange-like pterygoids slope up to the basi-occipital plane. In this view, the zygomata are seen to dip but slightly downward. Their point of greatest deflection lies high above a line drawn from the incisive alveolus to the occipital condyle—in fact, even above a line from the end of the nasal bones to the same point; at their lowest point, they are still on a level with the meatus, and they scarcely dip more than half-way from the top of the skull to the level of the molar crowns. For the rest, notable points of the profile view of the skull are the small size and peculiar position of the "anteorbital" foramen, here situate low down and far forward in the maxillary, near its antero-inferior angle; a deep pit, but not perforation, behind the zygomatic plate of the maxillary; extensive lacerate foramina of exit of nerves entering the orbit from the brain; similar fissured vacuities between the bulla ossea and the squamosal. The foreshortened tubular meatus is seen in the deep recess between the posterior root of the zygoma and the postero-inferior angle of the squamosal.

Viewed from behind, the occipital surface is seen to be nearly plane and vertical, with some beveling of the lateral (mastoid) portions. The most remarkable feature is the extent of this surface which is formed

by the mastoid. In *Geomys*, at any rate, the mastoids take as much part in the occipital surface as the occipital bone itself. The upper border of this surface is a nearly regular arch from one squamosal angle to the other. The lower outline is likewise a curve, with its convexity downward, but its regularity is broken by the nick of the foramen magnum in the middle, the protuberance of the condyles next, similar paroccipital processes next, and after a little interval the mastoid processes. Barring these irregularities of detail, the general occipital surface is elliptical in shape. In the middle, and niking the lower limb of the ellipse, is the foramen magnum, nearly all of which is vertical, and consequently not foreshortened in this view.

Viewed from below, the general contour is substantially like that presented from the opposite inspection, and we need only attend to details. The first feature is the incisive foramina—very small slits lying wholly in the intermaxillary bones, yet nearer to the molars than to the incisors, so great is the production of the rostrum. The palate proper,* *i. e.*, the intermolar portion, is extremely contracted, its width anteriorly being no greater than that of one of the molars. It widens a little backward. It is deeply twice furrowed, having a strong median ridge separating the furrows, and strong alveolar ridges on either hand. Posteriorly, there is a pair of deep pits extending to opposite the penultimate molars, and divided by a strong ridge. The palatal plate upon which these pits are constructed reaches considerably back of the molars in *Geomys;* less so in *Thomomys.* The general resemblance of the parts to some *Arvicolinæ* is strong. The pterygoids are thin, vertical, and somewhat circular plates, divaricating a little posteriorly, and abutting against the tips of the bulla ossea. They appear like a bifurcation of the median palatal ridge just mentioned. The post-palatal parts being contracted, like the palate itself, and compressed into small space, it is not easy to fully appreciate the conformation of the parts, and still less so to describe it. Moreover, the lamellar pterygoids are often broken off in careless preparation of the skull, and in such way that scarcely a suggestion of their former presence is left. Behind the pterygoids, the conspicuous bullæ osseæ appear convergent anteriorly to touch the former, prolonged into a tube exteriorly. Between them, the basioccipital space is cuneiform, (especially in *Thomomys*—more nearly quadrangular in *Geomys*,) with a median ridge and lateral depressions, nicked behind by a small portion of the foramen magnum. The skull finishes behind by an irregular curve, substantially the same as that described in speaking of the occipital plane.

In all but the oldest animals, the following sutures, or at any rate traces of them, persist: internasal, naso-intermaxillary, maxillo-intermaxillary, fronto-nasal, fronto-intermaxillary, and fronto-maxillary; maxillo-molar, squamo-parietal, squamo-malar, squamo-mastoid, occipito-mastoid, occipito-petrosal; basi-occipito-sphenoid; and there is fissured separation of the petrosal and tympanic from the squamosal. The various intricate relations of the palatals, and of the "sphenoid" as a whole, are inappreciable in the adult skull. Detailed relations of such of the individual bones as can be made out from the material before me, here follow:

The nasals reach back to a point opposite the anterior root of the zygoma, but extend little, if any, in the other direction, beyond the intermaxillaries. For two-thirds their extent they are narrow and approximately parallel in the examples of *Geomys* before me, and then rapidly expand. In all the *Thomomys* I have seen, they widen regu-

* The long upward-sloping anterior part of palate is not "palate" at all. In life, it is altogether outside the mouth, like the superior incisors, and covered with furry skin.

larly from the base to tip. They are flat at first, but toward the end become somewhat volute or scroll-like. They remain permanently distinct from the intermaxillaries, and have failed in no case to show me separation from each other.

The intermaxillaries run up on the forehead farther than the nasals—to or beyond the back instead of front border of the zygomata, being received in a deep emargination of the frontal. Below, similarly, they run far down on the false palate, ending opposite the back end of the incisive foramina. Their course around the side of the rostrum (maxillo-intermaxillary suture) may usually be traced as a strongly convex curve between the upper and lower points just mentioned—the most forward portion of the curve lying nearly midway between zygoma and incisors. The lateral surface is thrown into a curved elevation denoting the track of the incisor within. A strong alveolar plate dips down between the front teeth. The maxillary ends anteriorly in the curve just described; its other boundaries are obscured in adult life. The side is flat; it suddenly rises in a broad thin zygomatic plate, flush above with the general level of the top of the skull, there abutting (as shown by a long persistent suture) both with frontal and intermaxillary. This plate stands away nearly at a right angle with the axis of the skull, but very oblique to the other two planes. It circumscribes the orbit anteriorly; is excavated in the lachrymal region; its upper border is widened to a sharp-edged surface, and slopes gently outward, downward, and backward; its thin under margin rises to nearly meet the upper, finishing the laminar portion, and continuing to the malar bone as an angular process. A lachrymal bone is plainly indicated at the upper back part of the plate, but its extent and relations are not appreciable.

The frontal is much contracted, especially across the middle, having a somewhat hourglass-like superior outline, though both ends are angular. In front it sends a rectangular median process abutting against the nasals, and inclosed between the intermaxillaries; and an acute lateral process on each side, entering a recess between intermaxillary and maxillary. These sutures seem persistent. Behind, the fronto-parietal and fronto-squamosal sutures are commonly obliterated; when appreciable, the bone is seen to unite with the extremely narrow parietals by a directly transverse straight line, and with the squamosals by an oblique line on each side. These sutures persist longer on top of the head than in the orbital region.

The malar bone is a mere splint, reduced coincidently with the great extension of the zygomatic spurs of both squamosal and maxillary. It is somewhat clubbed anteriorly and overrides its support; behind, it is itself overlapped.*

The parietals, as already hinted, are singularly reduced in this family. In the skull of an old *Geomys*, the squamo-parietal suture is obscure or inappreciable, and the squamosals appear to meet each other at the above described ridge, on the median line; careful inspection, however, usually reveals a very irregular and much overlapping squamo-parietal suture, defining the parietals externally. These are of indeterminate shape, but tend to be narrowly rectangular; and, in *Thomomys*, a pair of pretty regular linear parietals is usually evident. There is constantly an interparietal—squarish or pentagonal in *Thomomys*, rather triangular in *Geomys*.

With such state of the parietals there is a corresponding overdevelopment of the temporal bone—especially of its squamosal element—though

*Although the zygoma in this family is a good stout arch, this reduction of the malar prepares us for the delicate thread-like condition of the parts in the next family, *Saccomyidæ*.

not to the extraordinary extent witnessed in *Saccomyidæ*, where the whole bone is blown up like a bladder. The squamosal roofs over most of the cranial cavity; and alone forms (with the exception of a little place occupied by the interparietal) the whole occipital or lambdoidal crest. The mastoid, which persists distinct from both squamosal and occipital, though usually fusing with the petrosal, is immensely developed, its superficies lying mostly in, and representing about half of each side of, the occipital surface. It develops a moderate "mastoid process," lying against the postero-external corner of the squamosal, and looking like a duplicate of the paroccipital process that lies against its opposite extremity. The petrosal does not share this unusual development, the bulla ossea being, in fact, smaller than they are in *Arvicola*, for instance; they swell but little below the baso-occipital plane. The tympanic developes into a tubular meatus, set quite free from its surroundings in a deep recess of the squamosal. The petrosal likewise is fissured away from the squamosal, but in adult life the tympanic, petrosal, and mastoid are consolidated.

The upper and lower parts of the occipital bone are at right angles with each other; the basi-occipital is horizontal upon the floor of the skull, while the superior and lateral elements are perpendicular behind. The supra-occipital is squarish, with rounded corners; the ex-occipitals develop into moderate obtuse processes. Nearly all of the foramen magnum is vertical; the condyles are rather small and widely divergent superiorly.

The suture with the basi-occipital, which persists for some time, is ordinarily the most conspicuous of the sphenoidal relations which may be appreciated in examination of adult skulls. Close inspection, however, shows the squamo-sphenoid suture just inside the glenoid fossa; the alisphenoid barely misses taking a part in the mandibular articulation (as in some marsupials); the orbito-sphenoid, lining the orbit behind, rises nearly to the top of the skull.

The mandible remains for consideration. This is eminently characterized by its massiveness and the emphasis of its various ridges and angles. Nevertheless the symphysis, though extensive, is incomplete. Instead of an edge below, the bone presents a broad, smooth, flattened area, bounded on the sides by a ridge indicating the limit of masseteric muscular attachment. The angle of the jaw is strongly exflected in a peculiar way. An oblique plate (the "descending process" in many rodents) arises from the inner side of the body of the bone, and curves strongly backward and outward, ending far exterior to the main part of the bone as a strong laminar process. Just inside of this, between it and the condyle, there is a strongly marked, smooth, upright protuberance. This is where the root of the incisor pushes up from the inside. To the inner side of this knob, again, rises a third protuberance; it is the condyle, rather small and of no noteworthy features. (It appears particularly small when compared with the glenoid cavity, which, as I should have remarked before, is of unusual width.) Thus the mandible, viewed from behind, presents the curious appearance of three prongs—condyle, incisor knob, and exterior process. The appearance of trifurcation is best marked in *Thomomys*, where the tooth-knob is most prominent, and separated by deepest notches from the processes between which it stands. In addition to all these prominences, a slender falcate acute coronoid rises in front, and overtops the rest, being separated from the condylar ramus by a deep notch. There is a deep excavation between the thin laminar basis of the coronoid and the molar alveolus. The foramen of the inferior maxillary nerve appears on the inner side of the root of the condylar ramus.

The dental formula has been already given. The molar dentition

appears weak and slight in comparison with the enormous incisors. The under incisors, as already said in effect, run the whole length of the jaw, and push up a knob of bone behind. They are of the ordinary scalpriform construction, quite flat-faced, with converging sides and beveled to an edge behind. The superior incisors describe nearly a semicircle through the intermaxillaries and far into the maxillaries, to below the root of the zygoma. They are of distinct character in the two genera, furnishing the most ready means of diagnosis. In *Thomomys* the faces are plane, with a very fine groove running immediately along the inner margin; this groove frequently being indistinct or altogether wanting. In *Geomys*, on the other hand, this fine groove may or may not co-exist with another much stronger one which deeply channels the face of the tooth. This is as in *Dipodomys* and *Perognathus* of *Saccomyidæ*, *Ochetodon*, *Reithrodon*, and *Synaptomys* of *Muridæ*, &c. The position of this main groove even distinguishes species of *Geomyidæ*. In *G. bursarius* it is approximately central, and is accompanied by the fine marginal line of impression. In *G. pineti* it is rather more exterior, and the marginal groove may become obsolete. In *G. castanops* and *G. mexicanus*, there is no trace of an inner fine groove, and the main one exactly bisects the face of the tooth. In *G. hispidus*, finally, the main groove, which is not accompanied by a marginal one, lies in the inner moiety of the tooth.

The molars are perennial rootless prisms, as in *Arvicolinæ* and many other hard gnawers, but are small and of a very simple structure—at least in comparison with the complicate character which obtains in many rodents. The whole molar series is scarcely one-seventh of the length of the skull. They are implanted very obliquely to suit the peculiar conformation of the parts. The axis of the anterior upper molar slopes backward at an angle of about 45°, and the rest succeed with regularly diminishing obliquity. The relation is reversed in the lower jaw, where the back molar slopes forward, the rest becoming successively more nearly perpendicular. There is the same number of teeth in both jaws, and they are quite similar in construction. The anterior molar in each jaw is a double prism; the others are single and simple, elliptical in cross-section, the first being a pair of ellipses laid together like a short broad figure-of-eight, and the last approaching a cylindrical figure. The relation of the molars to each other is somewhat singular. Their roots are all widely diverging, but their crowns come into close contact. This is effected by the curve in their axis. Thus the front upper molar is curved with the convexity posterior; the rest are curved successively more and more, with the convexity anterior. Similar characters mark the under molars, though less strongly; and there is seen in these teeth, especially in the anterior ones, a lateral as well as fore-and-aft curve. This shape appears to be forced upon the teeth by the peculiar conformation of the alveoli. The molars are quite similar in the two genera, and scarcely afford diagnostic characters, especially since there is some change in the details of the molar crowns, with age and wear of the teeth. On the whole, however, it may be observed that in *Geomys* the molars—the immediate ones at any rate—are more perfectly elliptical than they are in *Thomomys*, where a pinching together of the exterior portion of the ellipses tends to result in a pyriform contour.

The principal cranial and dental characters of the two genera which compose the *Geomyidæ* may be shortly contrasted, as follows:

GEOMYS.	THOMOMYS.
Superior incisors deeply channeled along the middle, with or without a fine marginal groove.	Superior incisors without median sulcus, but with a fine marginal groove, (sometimes obsolete.)

Crowns of intermediate molars truly elliptical.	Crowns of intermediate molars acute-edged exteriorly.
Root of inferior incisor but little protuberant on outside of base of condylar ramus; end of mandible thus only 2-pronged, with a knob between.	Root of inferior incisors causing a protuberance on outside of base of condylar ramus nearly as high as condyle itself; end of mandible thus singularly 3-pronged.
Zygomata widest across anteriorly, thence contracting; the width behind little, if any, greater than the intermastoid diameter of the skull.	Zygomata regularly convex outward, with a sweeping curve, their breadth across posteriorly decidedly greater than the intermastoid diameter of the skull.
Parietals ridged along their line of union with each other.	Parietals ridged externally, near the squamo-parietal suture.
Interparietal triangular.	Interparietal rather pentagonal.
Nasals approximately parallel-edged part way, then suddenly widening.	Nasals widening uniformly from behind forward.
Superficies of mastoid bone occupying nearly half the occipital surface of the skull on each side.	Superficies of mastoid bone restricted to less than a fourth of the occipital surface on each side.
Bullæ osseæ less inflated, quite acute anteriorly.	Bullæ osseæ more inflated, quite obtuse anteriorly.
Basi-occipital, in the middle, about as broad as the width of the bulla at the same point.	Basi-occipital, in the middle, much narrower than the bulla at the same point.
A pair of broad deep pits on the palate behind, extending forward to opposite the penultimate molars.	A pair of slight pits on the palate behind, not extending beyond the ultimate molars.
Pterygoids ——? (will be found differing appreciably from those of *Thomomys*.)	Pterygoids appearing like a bifurcation into two thin diverging plates of a single median vertical palatal plate.

In like manner we may proceed to compare some of the principal cranial characters of *Geomyidæ* and *Saccomyidæ*. Notwithstanding the unquestionable close affinity of these two families, which must stand next to each other in the system, their crania are curiously different in general appearance and details of contour. The discrepancies are, however, of a superficial character, resulting mainly from the extraordinary molding of the parts in *Saccomyidæ*. In other words, it is a matter of mere *shape*, for the most part. There are, however, some curious and more essential features, of which the enormous inflation of various elements of the temporal bone,* and peculiar zygomatic relations posteriorly, are the most remarkable. Probably, going into details, a hundred actual differences between the skulls of *Geomyidæ* and *Saccomyidæ* might be enumerated. I shall content myself with tabulating a few of the more important of these. The comparisons are made between *Geomys bursarius* and *Dipodomys ordi*.

GEOMYIDÆ.	SACCOMYIDÆ.
Skull massive, angular, in general like that of *Arvicola*, &c.	Skull thin and papery, the corners rounded off; the resulting general shape peculiar.

* "Presenting a ludicrously close resemblance to the buttocks of the squatting human figure," as Baird has aptly said.

Interorbital space the narrowest part of the skull—narrower than rostrum.	Interorbital space expanded, very much broader than the rostrum.
Occipital region approaching a plane surface, without median emargination.	Occipital region formed chiefly of enormous bulging mastoids, with deep median emargination.
Nasal bones not produced beyond vertical plane of incisors; rostrum broad, parallel-sided.	Nasal bones produced far beyond incisors; rostrum attenuated, tapering.
Parietals small, linear, remote from the orbits.	Parietals large right-angled triangles, together as broad as the frontal, reaching orbits.
Occipital of an ordinary character, not attaining top of skull.	Occipital reduced and of peculiar shape; a part of it mounting the top of the skull.
Temporal bone, though of great extent, not remarkably inflated.	Temporal bone unique in its enormous size and inflation, being blown up like a bladder; the swollen mastoids forming most of the occipital plane; the two temporals larger than all the rest of the skull together.*
Squamosal roofing most of the cerebral cavity.	Squamosal restricted to the orbit.
Zygomata of an ordinary character, with the usual connections.	Zygomata thread-like in most of their extent, and greatly depressed in position; *the malar bone abutting against* the tympanic.
Tympanic, a contracted tube.	Tympanic, an inflated vestibule.
Petrosals discrete from each other, in contact with basi-occipital.	Petrosals in mutual contact at their extremities, and fissured away from basi-occipital.
Mastoid excluded from roof of cerebral cavity.	Mastoid roofing most of cerebral cavity.
Zygomatic process of maxillary, a plate with merely thickened upper border.	Zygomatic process developing into a shield over much of the orbital space.
Palatal outline strongly ascending and arched anteriorly; molars far below level of zygomata.	Palatal profile nearly straight and horizontal; molars on a level with the zygomata.
Incisors large, parallel-edged, scarcely converging.	Incisors small, acuminate, convergent.
Anterior molar, a double prism.	Anterior molar, a single prism.
Root of inferior incisor protuberant posteriorly.	Root of inferior incisor not prominent posteriorly.
Large erect falcate coronoid, overtopping condyle.	Minute prickle-like sloping coronoid, far below level of condyle.
&c. &c.	&c. &c.

* If the sense of hearing of *Dipodomys* be coördinated with the osseous development of the auditory apparatus, it must be extraordinarily acute.

SYNOPSIS OF INSECTIVOROUS MAMMALS.

By Theodore Gill.

PREFATORY.

The following arrangement of the primary and secondary groups of the order *Insectivora* has resulted from the study of the relations of the American forms and their comparison with those of other parts of the world, undertaken partly in continuation of the author's "Arrangement of the Families of Mammals," and partly for a general work on the mammals of North America. Clear ideas respecting the affinities of the forms represented in the several regions of the globe are necessary for the appreciation of the general features of geographical distribution, and any misappreciation of such relations may entail very serious errors in our ideas respecting the range of any given type. It is only necessary to refer to the memoirs of Pomel to understand what diverse conclusions may result as to the distribution of the major groups from the application of different taxonomic principles. The order *Insectivora* has been a somewhat favorite one among therologists, and the diversity of opinion respecting the affinities of the various forms has been very great. As several of the naturalists who have most differed from each have almost equally great reputations, recourse was necessary to the original materials to enable a critical opinion to be entertained respecting their several merits. This examination has led to the conclusions embodied in the following synopsis. The points of agreement with and difference from previous essays may be best exhibited by a partial historical *résumé*, in which only the chief systems need be passed in review.

HISTORICAL.

EARLY HISTORY.

The representatives of this group have been associated with rodents,* on account of similarity of form; under the name *Bestiæ*, with types having an exceptional dentition, at one time by Linnæus; and, more generally, with typical carnivores, on account of adaptation by molar and other teeth for carnivority, till Cuvier, in 1816, combined them into a peculiar "family" (the second) of his "Carnassiers," under the name "Insectivores;" the "Chéiroptères," "Carnivores," and "Marsupiaux" being co-equal families. This combination was first recognized as an order by Charles Bonaparte, who gave to it the Linnæan name *Bestiæ*. Not long after (in 1837), Bonaparte also separated the order by a great interval from the *Carnivora*, and combined it with the *Bruta* or *Edentata*, the *Cheiroptera*, and the *Glires*, in a major section of placental mammals, which he named *Ineducabilia*. This innovation, however, was very tardily adopted, al-

* Deceptive analogies were also found, *e. g.* Lichtenstein (K. M. H). Ueber die Verwandtschaft der kleinen (insectenfressenden) Raubthiere mit den Nagern. <Abhandl. K. Akad. Wiss. Berlin, 1831, pp. 345–360.

though Professor Owen, from his own investigations, had arrived at similar conclusions, but disguising the similarity by the application of a different name. But the appreciation of the additional differences of the Insectivores from the Carnivores in placental characters, as well as in the skeleton and visceral economy, has at length procured the general adoption of the order and its isolation from the Carnivores.

The typical insectivorous mammals known to Linnæus were distributed by him among three genera, *Talpa*, *Sorex*, and *Erinaceus*, besides *Galeopithecus*. Various genera were successively dismembered from these or subsequently discovered, but the confidence in the value of form distinctive of each type, as a taxonomic denominator, was long entertained, and an eminent anatomist* so entirely disregarded the lessons of his own experience as to combine the forms known in 1838 in the three Linnæan genera, with the various groups apportioned in the following manner:

Talpa:
- Chrysochloris.
- Talpa.
- Talpa-Sorex (=Scalops).
- Condylura.

Sorex:
- Mygale.
- Solenodon.
- Sorex.
- Macroscelides.
- Glisorex (=Tupaia).

Erinaceus:
- Gymnura.
- Erinaceus.
- Centetes.
- Ericulus.

Gray, 1822.

As early as 1822, Dr. John Edward Gray recognized the family value of four of the groups still retained with that value, in one case only (*Mygalidæ*) adding to a family an utterly incongruous element (*Chrysochloris*). He united these families with the *Ursinidæ* (comprising *Ursus*, *Procyon*, *Meles*, and *Gulo*) in an order (2. *Plantigradæ*) of unguiculate quadrupeds, and to another (1. *Pterophoræ*) referred alone the family *Galeopithecidæ*. His arrangement and nomenclature of the insectivorous families were as follows; the cacography and punctuation of the several genera being in every respect reproduced from the original: †

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* Blainville (H. de). Note sur les carnassiers insectivores. <Ann. franç. et étrang. d'anat. et de physiol., I, 315–316, 1837.

† *Fam.* 1. Erinacidæ.—Teeth, grinders acutely tubercular, cutting six in each jaw, two middle ones largest; canine very short; body spiny, forming a ball: tail very short: ears external.

1. Hedgehog, Erinaceus. Lin. E. europeus. Lin.

Fam. 2. Soricidæ.—Teeth, grinders acutely tubercular, cutting, acute, six or eight in each jaw, two middle very long; canine very short: body hairy: ears external: clavicles perfect.

Shrew, Sorex. Lin. S. araneus. Lin.

Fam. 3. Myaladæ.—Teeth, grinders, with acute tubercles, cutting six or eight in each jaw, two middle very small, next long, canine very short body hairy: tail none, or compressed, scaly: ears none, external: eyes small.

1. Desman, Mygale. Cuv. Sorex moschatus. Lin.
2. Scalops. Cuv. Sorex aquaticus. Lin.
3. Condylura. Illig. Talpa cristata. Lin.
4. Chrysochlore, Chrysochloris. Cuv. Sorex auratus. Lin.

Family Erinacidæ:
  Genus Erinaceus.
Family Soricidæ:
  Genus Sorex.
Family Myaladæ:
  Genus Myale.
  Genus Scalops.
  Genus Condylura.
  Genus Chrysochlore.
Family Tenrecidæ:
  Genus Tenrec.
  Genus Eteocles.

GRAY, 1823–1843.

Soon afterward, however (in 1823), Dr. Gray abandoned this classification, and, adopting the quinarian system, combined all the insectivorous genera in one (the third) family (which he named *Talpidæ*), of the second order of his system (*Feræ*). This last arrangement was retained by its author for many years, and was finally developed in a "Systematic list of the genera of mammalia, with their synonyma," introductory to a museum-catalogue,* in the following manner (the Graiian cacography being repeated): †

Fam. 3.—Talpidæ.

* *Fossores.*

a.—Talpina.

Talpa, Linn.
Hylomys, Temm.

b.—Crysochlorina.

Scalops, Cuv.
  Talpasorex, Lesson (not Schinz).
Chrysochloris, Cuv.
  Aspalax, Wagl. (not Oliv.)
Astromyctes, Harris.
  Rhinaster, Wagler.
  Condylura, Illig.
  Talpasorex, Schinz (not Lesson).

** *Ambulatores.*

c.—Tupaina.

Tupaia, Raffles.
  Cladobates, F. Cuv.
  Sorexglis, Diard.
  Glisorex, Desmar.
  Hylogale, Temm., Wagler.

d.—Erinacina.

Macroscelides, A. Smith.
  Rhinomys, Licht.

Fam. 4. Tenrecidæ.—Teeth, grinders, acutely tubercular; cutting, small, equal, six above four below; canine long: body spinous: tail none.
  Tenrec. Cuv. Erinaceus caudatus. Lin.
  Eteocles. Gray. Erinaceus subspinosus. Cuv.

* Gray (J. E.) List of the specimens of mammalia in the collection of the British Museum. Printed by order of the trustees: London, 1843. 16mo, pp. xxi–xxii.

† It is to be remarked that the families (3) Talpidæ (= order Insectivora), (4) Macropidæ (= order Marsupialia), and (5) Phocidæ (= order Pinnipedia), are combined together as abnormal Feræ (** Abnormales) and thus contrasted with the normal Feræ, (*Normales,) or families (1) Felidæ (=Felidæ, Hyænidæ, Protelidæ, Viverridæ, Canidæ, Mustelidæ,) and (2) Ursidæ (= Ursidæ, Procyonidæ, Cercoleptidæ, and Æluridæ).

Sorex, Linn.
    Pachyura, Selys.
Crocidura, Wagler.
    Suncus, Ehrenb.
Myosorex, Gray.
Corsira, Gray.
    Amphisorex (No. 1.) Duvern.
Blaria, Gray.
    Blarina, Lesson.
? Otisorex, Dekay.
Crossopus, Wagler.
    Hydrosorex, Nath., Duvern.
    Pinalia, Gray.
Solenodonta, Brant.
    Solenodon, Lesson.
Myogalea, Fischer.
    Mygale, Cuv. (not Fab.)
    Caprios α, Wagler.
Galemys, Wagler.
    Mygalina, I. Geoff.
    Caprios β, Wagler.
Gymnura, Raffles, Lesson.
    Echinosorex, Blainv.
? Echinops, Martin.
Erinaceus, Linn.

e.—Centetina.

Centetes, Illiger.
    Centenes, Desm.
    Setifer, Cuv.
    Tenrec, Lacep.
Ericulus, I. Geoff.

It is difficult to conjecture what physiological, structural, or other characters could give rise to such combinations as these, thus exhibited. Certainly, they cannot for a moment be supported against any critical examination.

POMEL, 1848 and 1849.

In 1848 and 1849, Pomel* published the results of his studies of the living and extinct species of the order in several articles on the classification, geographical distribution, and geological range of the group. Pomel recognized this group only as a suborder of "carnassiers." This position he regarded as not at all doubtful,† the adaptation for regimen deciding the question, and indicating a transition between the carnivores and cheiropters. The several members are then combined into two families, according as they are more or less adapted, by modifications of the anterior members, (1) for digging, or (2) for not digging ("non fouisseurs ou simplement terriers"†). How little even these purely teleological divisions are sustained by the facts will be evident to those

* Pomel (A.) Études sur les carnassiers insectivores. (Extrait.) < Arch. de phys. et nat., ix (1re partie—Insectivores fossiles) 159–165; (2me partie—Classification des insectivores), 244–251, 1848.

Pomel (A.) Sur la distribution géographique des mammifères insectivores monodelphes. < Bull. Soc. géol. France, 2 sér., vi, 56–64, 1849; abstracts, Archives sc. nat. et phys., x; Fror. Not., 3. Reihe, xi, No. 224, 49–53, 1849.

† "La place et la valeur du groupe d'abord ne me paraissent pas douteuses."—Arch. sc. phys. et nat., ix, 244.

familiar with the habits of the several forms after the consideration of the details of his system.

1re famille. Spalacogales. (Spalacogalæ).
  1re tribu. 1. Talpiens (Talpina).
    1er type. Pachyrhiniens.
      Talpa. Europe, Asia.
      Mogera. [Talpa Wcogura, Temm.] Japan.
      Geotrypus. (Fossil.)
      Astromycter. (N. Amer.)
      Galeospalax. (Fossil.)
    2e type. Leptorhiniens.
      Hyporyssus? (Fossil.)
      Scalops. (Mex., N. Amer.)
      Scapanus. (N. Amer.)
  2e tribu. Mygaliens (Mygalina).
    1er type. Amblysomiens.
      Chrysochlora. (S. Africa.)
      S. G. Amblysomus.
    2e type. Macruriens.
      Mygale. (Europe).
      Solenodon. (West India).
    3e type. (Unnamed.)
      [Plesiosorex. (Fossil.)]
      [Mysarachne. (Fossil.)]
      Urotrichus. (Japan, California.)
      Plesiogale. (Fossil.)
      Mysarachne. (Fossil.)
  3e tribu. Soriciens.
      Talpasorex. (N. Amer.)
      Sorex. (Ind., Eur., Afr., N. Amer.)
        1re section. Blarina. (N. Amer.)
        2e section. Corsira. (N. Amer.)
        3e section. Otisorex. (N. Amer.)
        4e section. Hydrogale. (N. Amer.)
      Galemys.
        1re section. Brachysorex. (N. Amer.)
        2e section. Crossopus. (Eur., Ind.)
        3e section. Pachyura. (Old World.)
      Musaraneus.
        1re section. Cryptotis. (N. Amer.)
        2e section. Myosorex. (Afr.)
        3e section. Crocidura. (Old World.)
2e famille. Galerices.
  1re tribu. Glisoriciens. (Glisoricina).
    1re type. Hylogaliens.
      Sorexglis? (Old World.)
      Oxygomphius. (Old World.)
    2e type. Dipogaliens.
      Macroscelis. (Afr.)
      S. G. Petrodromus.
  2e tribu. Echinoidiens. (Echinoidea).
    1er type. Galericiens.
      Echinogale. (Mad.)
      Hylomys. ("Hyllomis.") (Java.)
      Gymnura. (E. Ind.)
      Galerix. (Java.)

2e type. Erinaciens.
Erinaceus. (Eur. and Asia.)
S. G. Atelerix (4 dactylus).
3e type. Ericuliens.
Echinops. (Mad.)
Ericulus. (Mad.)
Centetes. (Mad.)
[Echinodes. Mad.]

GERVAIS,* 1854.

Among noteworthy laborers in the same field is Professor Paul Gervais. That eminent zoologist, in his "Histoire naturelle des mammifères," has proposed an original classification of the order, and has discriminated many previously unrecognized groups, and among them a number of subfamilies which appear to merit adoption in any system wherein the subordination in value of characters is deemed worthy of expression. The following scheme will give an idea of the arrangement:

Famille des Érinacidés.
Tribu des Tupaias.
Genre Tupaia (Tupaia, Raffles).
Genre Hylomys (Hylomys, Temminck et Schlegel).
Genre Ptilocerque (Ptilocercus, Gray).
Tribu des Hérissons.
Genre Hérisson (Erinaceus, Linné).
Tribu des Gymnures.
Genre Gymnure (Gymnura,—).
Tribu des Tanrecs.
Genre Tendrac (Ericulus, Is. Geoffroy).
Genre Tanrec, (Centetes, Illiger).
Famille des Macroscélidés.
Tribu des Macroscélidiens.
Genre Macroscélide (Macroscelides, A. Smith).
Le genre Pétrodrome (Petrodromus, Peters).
Tribu des Rhynchocyons.
Genre Rhynchocyon (Rhynchocyon, Peters).
Famille des Soricidés.
Tribu des Musaraignes.
Genre Musaraigne (Sorex, Linné).
§ 1. Crocidure (Crocidura, Wagler).
§ 2. Pachyure (Pachyura, de Sélys).
§ 3. Crossope (Crossopus, Wagler).
§ 4. Amphisorex (Amphisorex, Duvernoy).
Tribu des Solénodontes.
Genre Solénodonte (Solenodon).
Genre Urotriche (Urotrichus, Temminck).
Tribu des Desmans.
Genre Desman (Mygale, G. Cuvier).
Famille des Talpidés.
Tribu des Chrysochlores.
Genre Chrysochlore (Chrysocloris, G. Cuvier).

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* Gervais (Paul). Histoire naturelle des mammifères avec l'indication de leurs mœurs, et de leurs rapports avec les arts, le commerce et l'agriculture. . . . . [8vo, 2 v., viz :—]
1re partie. [Introduction, Primates, Chéiroptères, Insectivores, Rongeurs.] . . .
Paris, L. Curmer. . . . . 1854. (I) xxiv, 418 pp., 1 l., 18 col. pl., 14 uncol. pl.
[2e partie.] Carnivores, Proboscidiens, Jumentés, Bisulques, Édentés, Marsupiaux, Monotrèmes, Phoques, Sirénides et Cétacés. Paris, L. Curmer, ... 1855
(II) 2 p. l., 344 pp.. 40 col. pl., 29 uncol. pl.

Tribu des Scalopes.
  Genre Scalope (Scalops, G. Cuvier).
Tribu des Condylures.
  Genre Condylure (Condylura, Illiger).
Tribu des Taupes.
  Genre Taupe (Talpa, Linné).

The Dermopterous Insectivores were associated with the Primates, as by most of his predecessors, and formed the last family (Famille des Galéopithecides) of that order.

WAGNER,* 1855.

Dr. Johann Andreas Wagner, in his supplementary volume (1855) to Schreber's work on mammals, has given a monograph of the order, and referred to it the genus *Galeopithecus*, previously associated with the lemurs, or bats, or isolated as the type of a distinct order. There is nothing else especially noteworthy in his arrangement, and the encomiums which have been paid to it by some writers are not deserved. The degree to which it departs from a true exposition of the natural relations, as expressed in structure, may be readily seen on a comparison of his classification with Mivart's.

I. Fam. Dermoptera:
  1. Galeopithecus. (3 sp.)
II. Fam. Scandentia:
  2. Cladobates. (6 sp.)
    a) Tupaja. (sp. 1–5.)
    b) Dendrogale. (sp. 6.)
  3. Ptilocercus. (1 sp.)
  4. Hylomys. (1 sp.)
III. Fam. Soricina:
  5. Rhynchocyon. (1 sp.)
  6. Gymnura. (1 sp.)
  7. Macroscelides. (9 sp.)
    a) Rhinomys. (sp. 1–8.)
    b) Petrodromus. (sp. 9.)
  8. Sorex. (65 sp.)
    a) Crossopus. (sp. 1–3.)
    b) Soriculus. (sp. 4.)
    c) Sorex. (sp. 5–17+4 ?)
    d) Feroculus. (sp. 18.)
    e) Paradoxodon. (sp. 19.)
    f) Crocidura.
      †) Dentes intermedii 4. (sp. 20–34.)
      ††) Dentes intermedii 3. (sp. 35–50+1 ?)
      †††) Dent. interm. 2. (sp. 52–53.) Diplomesodon. (sp. 51.)
    g) Myosorex.
      *) Sedis incertæ. (sp. 54–59.)
      **) Species dubiæ. (sp. 60–65.)
  9. Solenodon. (1 sp.)
  10. Myogale. (2 sp.)

* Wagner (Johann Andreas). Die Säugethiere in Abbildungen nach der Natur und mit Beschreibungen. Eine Zusammenstellung der neuesten Entdeckungen auf dem Gebiete der Säugethierkunde bearbeitet. . . . Leipzig, Verlag von E. D. Weigel. 1855. [4to., 5 v.] [SCHREBER (J. C. D. von). Die Säugethiere in Abbildungen nach der Natur mit Beschreibungen. Supplementband. Fünfte Abtheilung.]

IV. Fam. Talpina:
  11. Urotrichus. (1 sp.)
  12. Scalops. (6+2? sp.)
  13. Rhinaster. (1+1? sp.)
  14. Talpa. (5+1? sp.)
  15. Chrysochloris. (6+2? sp.)
V. Fam. Aculeata:
  16. Centetes. (2 sp.)
  17. Ericulus. (1 sp.)
  18. Echinogale. (1 sp.)
  19. Erinaceus. (12 sp.)

PETERS, 1864.

A great advance to our knowledge of the group resulted from the labors of Professor Wilhelm Peters,* as well in the field as in the closet. While in Mozambique, as a traveling naturalist, he collected a number of previously unknown forms of singular interest, and subsequently, on occasion of a monograph of the genus Solenodon, co-ordinating these with the types before described, elaborated a classification of the order, in which, for the first time, anything like due attention was paid to the details of anatomical structure. Following Wagner, he extended the limits of the order to embrace the *Galeopithecidæ*, and the enlarged group was then subdivided as follows:

A. Darmkanal mit einem grossen Blinddarm.
  a. Unterschenkelknochen getrennt, Jochbogen vollständig.
    α Ulna unvollständig.
 I. *Galeopitheci.* Gatt. Galeopithecus Pall.
    β. Ulna vollständig.
 II. *Tupayæ.* Gatt. Cladobates Cuv., Ptilocercus Gray, Hylogale Schl., Müll.
  b Unterschenkelknochen verwachsen, Jochbogen vollständig.
 III. *Macroscelides.* Gatt. Rhynchocyon Pet., Macroscelides Smith.
B. Darmkanal einfach, ohne Blinddarm.
  a Unterschenkelknochen getrennt, kein Jochbogen, keine Bullae osseae, os tympanicum einfach ringförmig.
 IV. *Centetinæ.* Gatt. Solenodon Brandt, Centetes, Ill.,? Ericulus Geoffr.,? Echinogale Martin.
  b. Unterschenkelknochen verwachsen, Jochbogen vollständig, Gehörbullen mehr oder weniger entwickelt, Schädelhöhle vollständig.
    α. Aeussere Ohren wohl entwickelt.
 V. *Erinacei.* Gatt. Erinaceus L., Gymnura Vig. Horsf.
    β. Aeussere Ohren verkümmert oder fehlend.
 VI. *Talpina.* Gatt. Myogale Cuv., Urotrichus Temm., Condylura Ill. (Rhinaster, Wogl.), Scalops Cuv., Talpa L., Chrysochloris Lacep.

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* Peters (W.) Neue Säugethiergattungen aus den Insektenfressern und Nagern. <Monatsber. Akad. Wissensch. Berlin, 1846, 257–259.

Peters (W.) Naturwissenschaftliche Reise nach Mossambique auf Befehl seiner Majestät des Königs Friedrich Wilhelm IV in den Jahren 1842 bis 1848 ausgeführt von Wilhelm C. H. Peters, Mitglied der königl. Akademie der Wissenschaften zu Berlin. Zoologie.—I. Säugethiere. Mit sechsundvierzig Tafeln. Berlin: Druck und Verlag von Georg Reimer. 1852. (fol., xvi, 202 pp., 46 pl. col.)

Peters (W.) Ueber die Säugethiere-Gattung Solenodon. <Abhandl. Akad. Wissensch. Berlin, (1863,) 1864, pp. 1–22, pl. 1–3.

Peters (W.) Über die Classification der Insectivora, [besonders *Ericulus*, *Echinogale*, und *Potamogale.* <Monatsber. Akad. Wissensch. Berlin, 1865, 286.

c. Unterschenkelknochen verwachsen, kein Jochbogen, Schädelhöhle an der Basis zum Theil häutig, ossa tympanica einfach ringförmig.

VII. *Sorices.* Gatt. Sorex L.*

Mivart, 1867–1871.

In a similar spirit, the order was subsequently studied by Prof. St. George Mivart.† Prof. Mivart went into still greater detail, and allowed himself to be guided to a greater degree than Peters by the weight and coincidence of characters. The result was that his distribution into families was more perfect than that of any of his predecessors, the families much more fully defined, and the relations of all the constituents rendered far more readily appreciable even by the characters exposed. Originally promulgated in 1867, the author reviewed the subject in 1871, and found cause to make very few modifications, at the last period a new genus only having been based on a previously known species, and some additional characters having been introduced into the diagnoses of the families. The classification in question is exhibited in the following conspectus:

Family I. Galeopithecidæ.
Galeopithecus.
Family II. Macroscelididæ.
Macroscelides, Petrodromus, Rhynchocyon.
Family III. Tupaiidæ.
Tupaia, Ptilocercus, Hylomys.
Family IV. Erinaceidæ.
Gymnura, Erinceceus.
Family V. Centetidæ.
Centetes, [Hemicentetes, 1871,] Ericulus, Echinops, Solenodon.

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* A. Intestinal tract with a large cæcum.
a. Bones of lower leg separate; zygomatic arch complete.
α. Ulna imperfect.
I. Galeopitheci.—Galeopithecus.
β. Ulna perfect.
II. Tupayæ.—Cladobates, Ptilocercus, Hylogale.
b. Bones of lower leg coalesced; zygomatic arch complete.
III. Macroscelides.—Rhynchocyon, Macroscelis.
B. Intestinal tract simple, without cæcum.
a. Bones of lower leg separate; no zygomatic arch; bullæ osseæ none; os tympanicum ring-shaped.
IV. Centetina.—Solenodon, Centetes, ? Ericulus, ? Echinogale.
b. Bones of lower leg coalesced; zygomatic arch complete; bullæ osseæ more or less developed; cranium completely ossified.
α. Ears well developed.
V. Erinacei.—Erinaceus, Gymnura.
β. Ears rudimentary or absent.
VI. Talpina.—Myogale, Urotrichus, Condylura, Scalops, Talpa, Chrysochloris.
c. Bones of lower leg coalesced; no zygomatic arch; parts of the base of the skull membranaceous; os tympanicum ring-shaped.
VII. Sorices.—Sorex.

† Mivart (St. George). Notes on the osteology of the Insectivora. . . . . <The Journal of Anatomy and Physiology, I, 1867, 281—312; II, 1868, 117—154.
Contains a descriptive synopsis of the order.

Mivart (St. George). Notes sur l'ostéologie des insectivores. . . . . <Annales des sciences naturelles. Cinquième série. Zoologie et paléontologie, VIII, 1867, 221–284; IX, 1868, 311—372.
A translation of the preceding.

Mivart, (St. George). On Hemicentetes, a new genus of Insectivora, with some additional remarks on the osteology of that order. <Proc. Zool. Soc. London, 1871, 58–79, with nine figs., pl. v.
The character of the families are reproduced, with additions.

Family VI. Potamogalidæ.
Potamogale.
Family VII. Chrysochloridæ.
Chrysochloris, Calcochloris.
Family VIII. Talpidæ.
Sub-family 1. Talpina.
Scalops, Scapanus, Condylura, Talpa.
Sub-family 2. Myogalina.
Urotrichus, Myogale.
Family IX. Soricidæ.
Sorex.

Prof. Mivart's labors in this department are undoubtedly worthy of the highest eulogium.

FITZINGER, 1867–1869.

A recent laborer on the several groups of the order is Dr. Leopold J. Fitzinger. In five successive memoirs on the Erinacei,* Macroscelides,† Sorices,‡ Talpæ,§ and Cladobatæ,|| he passed in review the constituents, so far as known to him, of this group. The author evinced considerable knowledge of the older literature respecting the order, but appears to have been almost totally ignorant of what has been written within late years. Ignoring, too, the principles of scientific zoology, he has disregarded the anatomical characteristics of the animals, and has been influenced in making his combinations into families almost solely by their external features. Thus, (1) in one group (Erinacei) are combined those genera that are covered with spines or stiffened hairs; (2) in another (Sorices), those of a mouse-like habit; (3) in a third (Talpæ), those whose foré feet are adapted for digging, and whose form and pelage are correspondingly modified; (4) in a fourth (Macroscelides), those which are fitted by elongated hind legs for leaping; (5) and in a fifth and last group are associated arboreal insectivorous animals having a squirrel-like appearance. This is essentially the sequence adopted in his popular zoology, and which apparently he designed not to deviate from in his late memoirs. The several articles have no value, except perhaps as references to the older works in which species have been described, and are in every respect anachronistic. The genera recognized or newly introduced are numerous, and are as follows:

Familie der Igel (Erinacei).
1. Gatt. Igel (Erinaceus).—4 sp.
2. Gatt. Stummeligel (Peroëchinus).—2 sp.
3. Gatt. Halbigel (Hemiechinus).—15 sp.

* Fitzinger (L. J.) Die natürliche Familie der Igel (*Erinacei*) nach dem gegenwärtigen Stande der Wissenschaft. <Sitz. Math.-Nat. Cl. K. Akad. Wiss. Wien, (1,) LVI, 844–890 1867.

† Fitzinger (L. J.) Über die natürliche Familie der Rohrrussler (*Macroscelides*) und die derselben angehörigen Arten. <Sitz. Math.-Nat. Cl. K. Akad. Wiss. Wien, (1,) LVI, 914–946, 1867.

‡ Fitzinger (L. J.) Kritische Untersuchungen über die der natürlichen Famlie der Spitzmäuse (*Sorices*) angehörigen Arten. <Sitz. Math.-Nat. Cl. K. Akad. Wiss. Wien, (1,) LVII, viz:
Abtheilung I, LVII, 121–180.
Abtheilung II, LVII, 425–514.
Abtheilung III, LVII, 583–644, 1867.

§ Fitzinger (L. J.) Die natürliche Familie der Maulwürfe (*Talpæ*) und ihre Arten, nach kritischen Untersuchungen. <Sitz. Mat-Nat. Cl. K. Akad. Wiss. Wien, (1,) LIX, 353–429, 1869.

|| Fitzinger (L. J.) Die natürliche Familie der Spitzhörnchen (Cladobatæ). <Sitz. Math.-Nat. Cl. K. Akad. Wiss. Wien, LX, 263–289, 1869.

4. Gatt. Trugigel (Echinogale).—1 sp.
5. Gatt. Spitzigel (Ericulus).—2 sp.
6. Gatt. Borstenigel (Centetes).—3 sp.

Familie der Spitzmäuse (Sorices).
1. Gatt. Rattenschwanzrussler (Gymnura).—2 sp.
2. Gatt. Schwarzzahnspitzmaus (Paradoxodon).—1 sp.
3. Gatt. Dickschwanzspitzmaus (Pachyura).—27 sp.
4. Gatt. Wimperschwanzspitzmaus (Crocidura).—25 sp.
5. Gatt. Zierspitzmaus (Diplomesodon).—1 sp.
6. Gatt. Kerbzahnspitzmaus (Feroculus).—1 sp.
7. Gatt. Halbspitzmaus (Myosorex).—3 sp.
8. Gatt. Spitzmaüse (Sorex).—16 sp.
9. Gatt. Ohrspitzmaus (Otisorex).—2 sp.
10. Gatt. Kurzschwanzspitzmaus (Brachysorex).—5 sp.
11. Gatt. Maulwurfspitzmaus (Anotus).—1 sp.
12. Gatt. Trugspitzmaus (Soriculus).—1 sp.
13. Gatt. Wasserspitzmaus (Crossopus).—23 sp.
14. Gatt. Schlitzrüssler (Solenodon).—1 sp.
15. Gatt. Bisamrüssler (Myogale).—2 sp.

Familie der Maulwürfe (Talpæ).
1. Gatt. Rüsselmaulwurf (Urotrichus).—1 sp.
2. Gatt. Sternmaulwurf (Rhinaster).—4 sp.
3. Gatt. Wassermaulwurf (Scalops).—9 sp.
4. Gatt. Maulwurf (Talpa).—7 sp.
5. Gatt. Goldmaulwurf (Chrysochloris).—9 sp.

Familie Rohrrüssler (Macroscelides).
1. Gatt. Rohrrüssler (Macrocelis).—9 sp.
2. Gatt. Felsenrüssler (Petrodromus).—1 sp.
3. Gatt. Krallenrüssler (Rhynchocyon).—1 sp.

Familie der Spitzhörnchen (Cladobatæ).
1. Gatt. Spitzhörnchen (Cladobates).—7 sp.
2. Gatt. Zwergspitzhörnchen (Dendrogale).—1 sp.
3. Gatt. Pfeilspitzhörnchen (Ptilocercus).—1 sp.
4. Gatt. Ferkelspitzhörnchen (Hylomys).—1 sp.

GILL, 1872.

In 1872, the author of the present article, in his "Arrangement of the Families of Mammals,"* adopted a classification, which agreed, as to the number and constitution of the families, with that of Professor Mivart but differed in the sequence and combinations of those families.

The attempt was made then to exhibit the comparative relations and the subordination of the several groups in a more definite manner than had been previously done (1) by the combination of the several families into "superfamilies" and "suborders," and (2) by the division of several of the families into "subfamilies," most of the last corresponding in the main with several tribes previously designated by Professor Gervais.

The following abstract is a reprint of that part of the work relating to the Insectivora, the references being to Professor Mivart's Memoir in the Journal of Anatomy and Physiology, and Professor Gervais's Histoire Naturelle des Mammifères, already cited.

ORDER VI.—INSECTIVORA.

SUB-ORDER DERMOPTERA.

Galeopithecidae=Galeopithecidae, Miv., J. A. & P., ii, 1868, 124.

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* Gill (Theodore Nicholas.) Arrangement of the Families of Mammals. With analytical tables. Prepared for the Smithsonian Institution. [Part I.] Washington: Published by the Smithsonian Institution. November, 1872. [8vo., vi, 98 pp.]
[Smithsonian Miscellaneous Collections. 230.]

SUB-ORDER INSECTIVORA VERA.

(*Soricoidea.*)

Talpidae=Talpidae, Miv., J. A. & P., ii, 1868, 150.
a. Talpinae=Talpina, Miv., J. A. & P., ii, 1868, 151.
b. Myogalinae=Myogalina, Miv., J. A. & P., ii, 1868, 152.
Soricidae=Soricidae, Miv., J. A. & P., ii, 1868, 153.

(*Erinaceoidea.*)

Erinaceidae=Erinaceidae, Miv., J. A. & P., ii, 1868, 146.
a. Erinaceinae=Hérissons, Gerv., H. N. Mamm., i, 229.
b. Gymnurinae=Gymnures, Gerv., H. N. Mamm., i, 231.

(*Centetoidea.*)

Centetidae=Centetidae, Miv., J. A. & P., ii, 1868, 147.
a. Centetinae=Tanrecs, Gerv., H. N. Mamm., i, 223.
b. Solenodontinae < Solénodontes, Gerv., H. N. Mamm., i, 246.
Potamogalidae=Potamogalidae, Allm., T. Z. S., vi, 1–16.

(*Chryschloridoidea.*)

Chrysochlorididae=Chrysochloridae, Miv., J. A. & P., ii, 1868, 150.

(*Macroscelidoidea.*)

Macroscelididae=Macroscelididae, Miv., J. A. & P., ii, 1868, 143.
a. Rhynchocyoninae=Rhynchocyons, Gerv., H. N. Mamm., i, 238.
b. Macroscelidinae=Macroscélidiens, Gerv., H. N. Mamm., i, 235.
Tupayidae=Tupaiidae, Miv., J. A. & P., ii, 1868, 145.

(*Insectivora incertae sedis.*)

Leptictidae < *Leptictis*, Leidy, Ext. Mamm. Dak. & Neb., 345.

The progress of this work was arrested after the completion of the portion relating to the educabilian mammals by the insufficiency of the material at the hand of the author and his inability to examine the anatomy of many forms of the Cheiroptera, which immediately followed the Educabilia in his Arrangement.

The classification therein presented is therefore now for the first time attempted to be justified by the exposition of the characters distinctive of the various groups, but in one respect a deviation has been made from the arrangement cited. Therein the author, following the tabular scheme published some years before by Professor Peters, had the idea of dividing the *Insectivora vera* into two primary groups:—(1) those without a cæcum (*i. e.*, Soricoidea, Erinaceoidea, Centetoidea, and Chrysochloroidea), and (2) those provided with a well-developed cæcum (*i. e.*, Macroscelidoidea): again, the former group was subdivided into those with the molars bearing two triangles, or corresponding areas, on the one hand, and, on the other, those bearing single triangles. And this seemed then to be justified by the physiognomy of the forms contrasted as well as by the characters already exposed.*

A renewed consideration, however, has convinced the author that the characters then regarded as paramount are less suggestive than those

* The arrangement of the Bestiæ thus indicated may be expressed diagrammatically thus:

Talpidae.
Soricidae.
Erinaceidae.
Centetidae.
Potamogalidae.
Chrysochloridae.
Macroscelidae.
Tupayidae.

furnished by the structure of the molar teeth, and a modification is therefore introduced in the subdivision of the *Insectivora vera*, or *Bestiæ*, into two groups, distinguished, (1) one by the development of subequal fore and aft regions, and (2) the other by the development of single transverse triangles. That the physiognomy of the Macroscelidoidea, and especially the Tupaiidæ, is not as distinctive as might have first appeared is evident from the fact that a peculiar Indian form (*Hylomys*), long associated with the Tupaiidæ on account of its habitat and physiognomy,—and by such therologists as Gray, Gervais, Mivart, etc.,—proves now to be closely related to the Erinaceoid genus *Gymnura*.

MONOGRAPHIC ESSAYS.

The principal families have severally been the subjects of elaborate researches by naturalists; and special attention has been paid to the dentition of the Centetidæ,* Erinaceidæ,† Soricidæ,‡ and Talpidæ;§ while in late memoirs, the placental,|| cerebral,¶ and osteolog-

* Reinhardt (J.) Mælketandsættet og Tandskiftningen hos *Centetes ecaudatus* (Schr.) <Overs. Dansk Ved. Selsk. Forhandl. f. 1869, pp. 171–178, with woodcuts.

† Sahlertz (—). Tandsættet og Tandskiftet hos Pindsvinet(*Erinaceus europaeus*). <Videnskab. Meddels. fra Naturh. Forening Kjobenhavn for 1871, (3) III, 350–385, pl. 9, 1871–72. (Résumé français, 36–42.)

Sahlertz (—). Du système dentaire et du remplacement des dents chez le hérisson. <Journ. de Zool. Paris, 1873, pp. 275–281.

Reprint of the "Résumé français from Vid. Meddeels fra Nat. Forening Kjob., 1871–72, 36, 42."

‡ Gray (John Edward). [Revision of the genus *Sorex*, Linn.] <Proc. Zool. Soc. London, V, 123–126, 1837.

Duvernoy (G. L.) Fragmens d'histoire naturelle systématique et physiologique sur les Musaraignes (Sorex). < L'Institut, II, 299, 1834; Bibl. Univ., II, 195–196, 1836; Mém. Soc. hist. nat. Strasbourg, II.—36 pp. 3 pl. + (supplément) 7 pp., 1835.

Duvernoy (G. L.) Notices pour servir à la monographie du genre Musaraigne (Sorex, Cuv.) <Mag. de Zool. 1842,—Mamm., pl. 38–54 (with 48 pp.); Comptes Rendus Acad. Sc., Paris, XV, 7–13, 1842; l'Institut, X, 247, 248, 1842.

Duvernoy (G. L.) Sur les dents des Musaraignes, considérées dans leur composition et leur structure intime, leurs rapports avec les machoires, leur développement et leur succession. < Comptes Rendus Acad. Sc. Paris, XV, 270–278, 304–314, 483–491, 1842; Deutsch. Naturf. Versamml. Bericht., 225–226, 1842; France, Congrès Scient., 189–191, 1842.

Duvernoy (G. L.) Deuxième supplément au Mémoire sur les dents des Musaraignes et autres mammifères. <Comptes Rendus Acad. Sc. Paris, XVII, 98–105, 1843.

Duvernoy (G. L.) Sur les dents des Musaraignes, considérées dans leur composition et leur structure intime, etc. <Mem. prés. à l'Acad. d. Sc. Paris, Sc. math. et phys. IX, 333–432, 4 pl., 1846.

Peters (Wilhelm). Ueber die Gebissformel der Spitzmäuse. <Bericht Berlin Akad., 1852, 169–179; Archiv f. Naturg., XVIII, 220-227, 1852; Fror. Tagsber., No. 570 (Zool., III, 1852), 81–86.

Brandt (Édouard). Izslyedovaniya o zubnoi sistemye kutor i zemleroek. St. Petersburg, 1865. [8vo, 117 pp., with 6 pls.]

[Researches on the dental system of the shrews (*Sorex*, Cuv.)]

Brandt (Édouard). Untersuchungen über das Gebiss der Spitzmäuse (Sorex, Cuv.) mit 6 lithographirten Tafeln. <Bull. Soc. Imp. Nat. Moscou, 1868, XLI, 2e partie, 76–95, pl. 1–6, 1869; XLIII, 2e partie, 1–40, 1871.

§ Bate (C. Sp.) On the dentition of the common mole (Talpa Europæa). <Ann. and Mag. Nat. Hist., XIX, 377–381, 1867, with a plate, and (in full) Trans. Odontolog. Soc., V, 261–294, with 6 pls., 1867.

Moseley (Henry N.) and E. Ray Lankester. On the nomenclature of mammalian teeth, and on the dentition of the mole (*Talpa Europæa*), and the badger (*Meles taxus*). <Jour. Anat. and Physiol., III, 73–80, pl. II, figs. 5, 6, 1868.

|| Rolleston (George). On the placental structures of the Tenrec (*Centetes ecaudatus*), and those of certain other mammalia; with remarks on the value of the placental system of classification, ... 1863. <Trans. Zool. Soc. London, V, 285–316, pl. 50, 1866.

¶ Gervais (Paul). Mémoire sur les formes cérébrales propres à différents groupes de mammifères. <Journ. Zool., I, 425–469, pls. 20–23, 1872.

A memoir on the cerebral forms of Toxodon, Pteropodidæ, Galeopithecus, Erinaceids, Tupaia, Centetes, Ericulus, Macroscelis, Typotherium, Tragulus, Hyæmoschus, Oreodon, Cainotherium, Hyrax, Ondatra, Sciuropterus, Dipus, Spalax, Arctomys, Pedetes, Myopotamus, Synetheres, Lagostomus, Hystrix, Cœlogenys, Dasyprocta, Hydrochœrus, and Cavia.

ical* characters of various members of the group have been discussed and illustrated. Among the latest publications relative to members of the group are to be especially cited the Researches on Mammals of Messrs. H. and A. Milne-Edwards,† and a monograph on the genus *Hylomys* by Dr. John Anderson ;‡ in the former, several peculiar genera, previously briefly described by M. A. Milne-Edwards, are at greater length described and illustrated, and in the latter the external and internal characteristics of the animal are made known and the osteology figured in detail, and the correctness of the reference to the family *Erinaceidæ* rather than to the *Tupaiidæ* satisfactorily demonstrated.

RANGE OF VARIATION.

The studies undertaken to ascertain the various degrees of relationship of the several forms of the order were based on the skulls or skeletons § of representatives of each family and subfamily except *Potamogalidæ* and *Rhynchocyoninæ*, and were much facilitated by the memoirs of Professor Mivart. Indeed, so thoroughly had that gentleman applied himself to his task that little remained but to verify characters he had discovered; to intercalate forms unknown to him; and to express the subordination of the groups and their relations in a more decided manner. In order, however, to test this work, the writer of the present article examined the comparative characters of each part of the skeleton (so far as he had the material); collated the results of this examination with those of others; incorporated what else appeared to be reliable from others; and tabulated all the characters so found in parallel columns and contrasted terms.

After thus co-ordinating all the characters of each family, and checking the results then gained by renewed examinations, it began to appear that the most natural antithetical distribution of the non-flying forms would be into (1) those with broad (fore and aft) molars provided with two triangles or corresponding tubercles on the one hand, and (2), on the other, those with narrow molars furnished each with a single, well-developed triangular area. Assuming this division as a basis, the other parts of the organization could be best correlated, and the arrangement of the various forms became less involved. The successive contrasts of the remaining forms led to the results exhibited in the classification now submitted, and the elimination from the associations of forms familiar to the American student of (1) the *Macroscelididæ*, and then (2) the *Erinaceidæ*, leaving the *Soricidæ* and *Talpidæ* in closer mutual connection. These last, as now constituted, form a rather heterogeneous group, and it may be that the *Talpinæ* and *Myogalinæ* should be divorced, and distinguished as separate families. Inasmuch, however, as the resemblance in the skull is great,

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*Meckel (J. Fr.) Ueber die osteologischen Differenzen der Igelarten. < Beitr. zur vergl. Anat., I. Heft 1, 34–56, 1808.

Sundevall (C. J.) Öfversigt, af slägtet Erinaceus. <K. Vet. Akad. Handlgr., Stockholm, 1841, p. 215–240,—Isis, 1845, pp. 273–280.

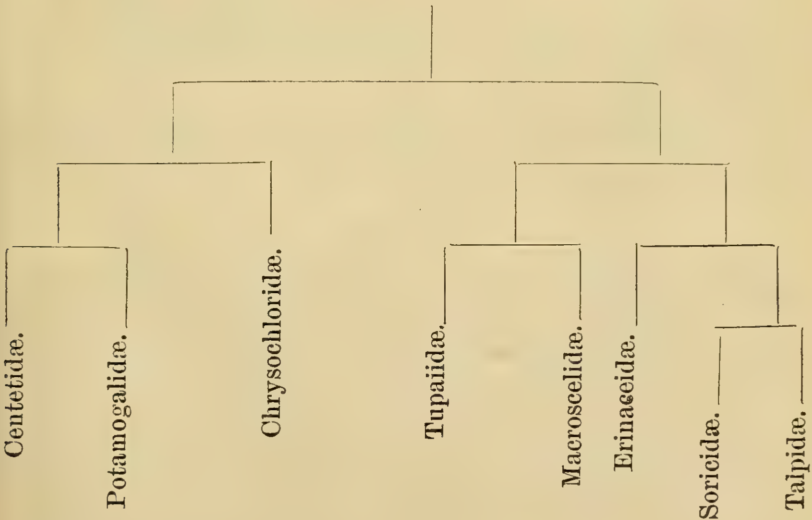
†Edwards (Henri Milne et Alphonse Milne). Recherches pour servir à l'histoire naturelle des mammifères. [2 vols.]—Paris: Victor Masson et fils. . . . 1868–1874. [4to, vol. I, 2 p. l. 394 pp.; vol. II, viii pp., 105 pl., with 105 l. explanatory.]

‡Anderson (John). On the osteology and dentition of Hylomys. <Trans. Zool. Soc. London, VIII, art. XIII=pp. 453–467, pl. lxiv, 1874.

§The specimens chiefly studied were in the museum of the Smithsonian collection; but I have also to record my indebtedness to Professor Marsh, in whose collections I found several skeletons I could not see elsewhere, and among these was at least one of the types (*Hemicentetes madagascariensis*) of Professor Mivart's descriptions, obtained from Mr. Gerrard.

and as the characteristic modifications chiefly affect the fore feet, for the present, at least, they are retained in the same family. The families adopted then are the same as those recognized by Professor Mivart. The points in which the present arrangement differs from his will be obvious on comparison thereof with his scheme reproduced in the historical *résumé*. It need only be remarked that external form and peculiarities appear to be almost valueless as expressions of affinity, except within a very narrow range. The external features are not co-ordinated with others; and, inasmuch as sound scientific principles dictate a classification based on the consideration of the entire economy, arrangements like those prevalent in the early days of zoology, and those recently published by Dr. Fitzinger, cannot but be considered, in the present state of our knowledge, as in a high degree scientifically unsound. The progress toward a scientific classification of the Insectivores has been chiefly effected by the offcast of the natural prejudice in favor of external characters for taxonomic use; but the lingering of such prejudice appears to be still manifested to some extent by the continued approximation, in one case, of the *Erinaceidæ* and *Centetidæ*, and, in another, of the *Chrysochloridæ* and *Talpidæ*: the sole title to approximation of the first pair seems to reside in the fact that representatives of each have spines; and, in the other instance, that some members of one group (*Talpinæ*) resemble the other in the cylindrical form and adaptation for subterraneous life; the characters, although having a certain suggestive value, are so completely gainsaid by the *tout ensemble* of the organization as to be of no value as taxonomic denominators. It remains yet to be learned, however, what significance the spinous armature may have in reference to the primitive characters and genetic relations of insectivorous forms; but, from present indications, it appears to be very illusive.

The successive degrees of relationship of the severally diverging forms of the order may be expressed in a tabular form, or "genealogical tree:"



The evidence is not sufficient to enable an exact determination to be made of the form which is most generalized; but inasmuch as the mon-

otrigonate type of dentition prevailed to a great extent in the older forms of the order, and as those forms are now characteristic of those regions in which generalized types exist in the greatest number, the monotrigonate Insectivores may provisionally be tenants of that rank. Future discoveries in palæontology and individual development may throw light on the subject.

GEOGRAPHICAL RELATIONS OF AMERICAN SPECIES.

Prepared from the standpoint thus obtained to inquire into the relations and distribution of those types represented by American species, the conclusions may be generalized as follows:

The North American species now living belong exclusively to groups confined to those quarters of the world in which have become developed the most differentiated types; that is, the great "Arctogæan" division. No forms clearly susceptible of more than "group" distinction from types characteristic of the Palæarctic province of that division exists within its limits. More detailed study gives the following results: In the family *Talpidæ* are several peculiar genera, representing even somewhat more comprehensive groups: thus, in the subfamily *Talpinæ* are two well differentiated groups:—(1) *Scalopes*, with two genera; and (2) *Condyluræ*, with one genus; while the *Talpæ* of the Old World are otherwise unrepresented in the new. The *Myogalinæ*, on the other hand, are represented by a genus (*Urotrichus*) whose typical representive is a Japanese animal, and from which, indeed, the Western American species seems to be scarcely distinguishable.

The *Soricidæ* are represented by genera either common to the nearctic and palæarctic faunas, or by extremely closely related ones.

In fine, the affinities existing between the Northern Old-World and New-World forms are such as to render it evident that whatever may be the origin of one, that, directly or indirectly, must be the source of derivation for the other. As the fauna of South America and the West Indies is exceptional, it is out of the question that the original center is there; and palæontological and physical geography, re-enforced by zoological geography, concur in pointing to the probability that to Asia we have to look for at least the secondary source of emigration of the arctogæan forms.

Without further preface, the contrasted differential characters of the various groups of the order are given, and their successive degrees of subordination exhibited in the following analysis:

INSECTIVORA.

Ineducabilian Placental Mammals,* with the anterior as well as posterior members primarily adapted for walking † (but secondarily modified for other purposes), the carpal bones of the proximal as well as distal series, and the metacarpal as well as phalangeal bones being normally differentiated and developed; the ulna and radius more or less distinct; the hind limbs normally related to the pelvis, and their elements

* Ineducabilian Placental Mammals, *i. e.*, Placentiferous Mammals with a brain whose cerebrum is relatively small and unilobate, (the sylvian fissure being obsolete and the posterior lobe undeveloped,) leaving exposed behind much of the cerebellum and in front much of the olfactory lobes, and with the corpus callosum extending more or less obliquely upwards, terminating before the vertical of the hippocampal sulcus, and provided with no well-defined rostrum in front.

† In contradistinction to the Cheiroptera, which have the manus primarily adapted for flying.

to each other, and without a calcar.* Teeth encased in enamel,† of three kinds, (*i. e.*, molars, canines, and incisors,) but more or less modified in form, and diphyodont; molars typically with sharp and pointed cusps; lower jaw with the condyles well defined, more or less transverse, and received into special glenoid sockets.‡ Placenta discoidal deciduate.

SUBORDERS

I. Insectivores with members modified for flight or progression in the air, the limbs being much elongated and very slender, and connected by an extension of the skin, which involves the wrists and ankles and advances forwards to the neck, and backwards, inclosing the tail. Lower jaw with the condylar portion extended outwards. Incisor teeth of lower jaw palmate, deeply pectinated; incisors of upper jaw, as well as anterior molars of both, compressed, and with their crests multicuspid.

DERMOPTERA.

II. Insectivores with members modified for walking or progression on the ground, the limbs being comparatively short and robust, and free. Lower jaw with the condylar portion not extended outwards. Incisor teeth of lower jaw conical, not pectinated; incisors of upper jaws, as well as anterior molars of both, more or less conical, and with their crowns unilobate.

BESTIAE.

DERMOPTERA seu PTEROPHORA.

I. GALEOPITHECIDAE.

Galeopithecus, Pallas, 1780,=Lemur, Storr, 1780, (not Linn.)§
 Galeopithecus (Galeopithecus), Gray.
 Galeopithecus (Colugo), Gray.
 Galeolemur, Lesson, Gray.

BESTIAE seu INSECTIVORA VERA.

FAMILIES.

I. Molars (*i. e.*, true molars), broad: upper severally with two completely separated areas (anterior and posterior), forming (1) more or less triangular prisms narrowed inwards, or (2) subequal halves; lower with two subequal halves (anterior and posterior), the posterior being almost as much developed as the anterior, triangular, and narrowed outwards.

1*a*. Intestinal canal with a large cæcum. (Pubic symphysis, attypically, elongated.) (*Tupaioidea.*)

2*a*. Squirrel-like, with soft pelage, adapted for arboreal life, and with the hind legs moderately developed. Tibia and fibula separate. Metatarsus moderate (little or no longer than tarsus). Skull with dorsum of muzzle transversely convex; orbit more or less encircled by bone; suboptic foramen none; alisphenoid canal developed; malar perforate; lachrymal foramen at margin or outside of orbit. Teeth: I., $\frac{2}{3}$ C., $\frac{1}{1}$; Pm., $\frac{3}{3}$; M., $\frac{3}{3} \times 2$; "upper molars with four more or less marked cusps and an external cingulum, which tends to form, with the two outer principal cusps, two triangular prisms;" canine more or less remote from the premaxillary suture.

TUPAIIDAE

2*b*. Mouse-like, with soft pelage, adapted for leaping, and with the hinder limbs much elongated. Tibia and fibula anchylosed together below. Metatarsus very elongated (much exceeding tarsus). Skull with dorsum of muzzle transversely concave; orbit not encircled by bone; suboptic foramen developed; alisphenoid canal none; malar imperforate; lachrymal foramen within the margin of orbit. Teeth: I., $\frac{3}{3}$ $(-\frac{1}{3})$; C., $\frac{1}{1}$; Pm., $\frac{3}{3}$; M., $\frac{3}{3}(-\frac{3}{4}) \times 2$; "upper molars quadricuspid, the anterior and posterior cusps being connected by transverse ridges."

MACROSCELIDIDAE.

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* In all the characters cited in the first several paragraphs, the Insectivora differ from the Cheiroptera.

† In the investment of the teeth in enamel, the Insectivora differ from the Edentata.

‡ In the character of the condyles and glenoid surfaces, the Insectivora differ from the Glires; at the same time, the character is not always well marked, as will be evident on inspection of the condyles in Talpidæ.

§ Skeleton, Blainv., Ost. Lemur, pl. 6. Skull, Blainv., Ost. Lemur, pl. 8, fig. 4 (above and below). Vertebræ, Blainv., Ost. Lemur, pl. 9, fig. 1 and 2 (part). Limbs, Blainv., Ost. Lemur, pl. 10, fig. 2, 3, 5, 8, 10 (part.) Teeth, Blainv., Ost. Lemur, pl. 11, fig. 8.

1*b*. Intestinal canal without a cæcum. (Pubic symphysis very slight or null.)

2 *a*. Molar teeth in part (M., 2; M., 1; Pm., 4; Pm., 3) quadricuspid, with the antero-internal cusp higher than the postero-internal; true molars (M., 2; M., 1) with the postero-external cusp connected by a ridge with the one between the antero-internal and the postero-internal cusps at the re-entering angle of the latter. Skull with the clavarium oblong, oval, broadest between the roots of the zygomata; with the foramen magnum triangular; the occipital condyles very divergent; with paroccipital and mastoid processes distinct. Pelage more or less harsh or spinigerous. (*Erinaceoidea.*)

ERINACEIDAE.

2*b*. Molar teeth multicuspid, with the cusps connected by deep re-entering ridges, which describe two elongated triangles, and with at least an extensive antero-internal ledge or cingulum. Skull with the calvarium wide; broadest about the periotic region; with the foramen magnum subcircular or oblong; the occipital condyles variously divergent; with the paroccipital processes obsolete or wanting. Pelage very soft. (*Soricoidea.*)

3*a*. Skull with the posterior ridges obsolete; with the foramen magnum oblong and inclined far forwards below; with no distinct postglenoid process; with the tympanic element forming a bulla; infraorbital canal an extensive transverse aperture, arched over by a very narrow osseous bar; zygomatic arch a slender rod; lower jaw with the ascending rami erect and without cavities at the bottoms of the coronoid processes. Teeth: molar with the postero-internal ledge obsolete or wanting. Vertebræ: cervical with no hypapophyses; dorsal and lumbar with no hyperapophyses. Sternum with manubrium broad and keeled. Anterior members developed more than the posterior; with carpus more or less enlarged, and at least with an os intermedium. Scapula long and narrow.

TALPIDAE.

3*b*. Skull with the posterior ridges well developed; with the foramen magnum subcircular and inclined little forwards below; with a well-developed post-glenoid process; with the tympanic element annular, not forming a bulla; infraorbital canal a rather long subcylindrical tunnel, covered by a very broad osseous wall; zygomatic arch not developed. Lower jaw with the ascending rami deflected outwards and each with a cavity at the bottom of the coronoid process. Teeth: molar with a postero-internal ledge armed with a cusp at its antero-internal angle. Vertebræ characteristic; cervical with well-developed hypapophyses; dorsal and lumbar with distinct hyperapophyses. Sternum with manubrium broad but ecarinate. Anterior members more slender than the posterior; with carpus normal, having no sickle-shaped bone or os intermedium; scapula short and broad.

SORICIDAE.

II. Molars (*i. e.*, true molars) narrow; upper each with a homogeneous, (or, as in Potamogalidæ, with an incomplete secondary area,) forming a triangular prism narrowed inward; lower simple (*e. g.*, Chrysochloridæ) or with two very unequal portions.

1*a*. Skull cylindrical or cylindro-conic, broadest between the glenoid surfaces. Malar bones absent. Tympanic bullæ none. Paroccipital processes developed. Carotid foramen none. Pelage more or less harsh. (*Centetoidea.*)

2*a*. Skull more or less cylindrical; with a lachrymal foramen whose mouth is close to the inner margin of the orbit; with no suboptic foramen. Teeth variable (I., $\frac{2}{2-3}$; C., $\frac{1}{1}$; Pm., $\frac{2-4}{2-4}$; M., $\frac{3}{3} \times 2$); the upper molars forming, severally, triangular prisms, single internal principal cusps only being developed; lower molars with very small posterior cuspidate ledges. Scapula with an obtuse metacromion process. Clavicles developed. Tibia and fibula separate from each other entirely.

CENTETIDAE.

2*b*. Skull cylindro-conic; with no lachrymal foramen; with a suboptic foramen. Teeth: I., $\frac{3}{3}$; C., $\frac{1}{1}$; Pm., $\frac{3}{3}$; M., $\frac{3}{3} \times 2 = 40$; the upper molars presenting, severally, incompletely divided triangular prisms, two principal internal cusps being developed; lower molars with quite large posterior ledges or areas. Scapula without a metacromion process. Clavicles suppressed. Tibia and fibula anchylosed together at their distal extremities.

POTAMOGALIDAE.

1*b*. Skull cuneiform, very broad and high, tapering rapidly forwards: broadest between the posterior roots of the malar bones. Malar bones well developed. Tympanic bullæ developed. Paroccipital process atrophied. Carotid foramen present. Pelage very soft. (*Chrysochloroidea.*)

CHRYSOCHLORIDAE.

TUPAIOIDEA

II. TUPAIIDAE.

Genera.

Tupaia, Raffles, 1821?,=Sorexglis Diard (fide Desm., 1822,)=Glisorex, Desmarest, 1822,=Cladobates, F. Cuvier, 1825 =Hylogalea, Temm., 1824,=Cladobates, F. Cuv., 1825.
Dendrogale, Gray.
Tupaja, Gray.
Ptilocercus, Gray, 1848.

III. MACROSCELIDIDAE.

SUBFAMILIES.

Incisor ($\frac{3}{3}$) teeth well developed in upper jaw. Skull narrow between orbits; with the snout moderately produced; with no postorbital processes; with the pterygoid fossa protended to the hinder margin of palate. Palate with extensive vacuities. Infraorbital canal very short. Lower jaw with its angle elongated. Vertebræ characteristic. Lumbar six or seven; cervical with spines rudimentary. Fore-arm with radius and ulna anchylosed. Extremities (all) with five digits.

MACROSCELIDINAE. (A.)

Incisor ($\frac{1}{3}$ or $\frac{0}{3}$) teeth exiguous or absent in upper jaw. Skull broad between orbits; with the snout much produced; with a distinct postorbital process bounding the orbits behind; with the pterygoid fossa not protended to the hinder margin of palate. Palate completely ossified. Infraorbital canal very long. Lower jaw with its angle very short. Vertebræ characteristic; lumbar eight; cervical with spines moderate. Fore-arm with radius and ulna separate. Extremities (all) with four digits.

RHYNCHOCYONINAE. (B.)

A. MACROSCELIDINAE.

Genera.

Macrcelides, A. Smith, 1829=Eumeres, I. Geoffr. St.-Hil., 1829=Rhinomys, Lichtenstein, 1833.
Petrodromus, Peters, 1846.

B. RHYNCHOCYONINAE.

Genus.

Rhynchocyon, Peters, 1847.

ERINACEOIDEA.

IV. ERINACEIDAE.

SUBFAMILIES.

Erinaceids with a rudimentary tail, and pelage in which robust spines are developed. Skull comparatively broad; with the muzzle short; scarcely constricted between the orbits. Foramina sphenopalatinum and rotundum near each other. Palate imperfectly ossified; with two elongated vacuities. Teeth: Pm., $\frac{3}{2}$; I., $\frac{3}{2}$; last molar (M., $\frac{3}{3}$) much reduced; upper I., $\frac{3}{2} \times 2$; canine teeth small (each generally with two roots.) Vertebræ modified; axis with the spinous process very slight; sacral three. Pelvis with the ischial tuberosities little prolonged backwards.

ERINACEINAE. (A.)

Erinaceids with a more or less developed tail, and pelage with no decided spines. Skull comparatively narrow, with the muzzle more or less elongated, more or less constricted between the orbits. Foramina sphenopalatinum and rotundum remote from each other. Palate completely ossified; without vacuities. Teeth: Pm., $\frac{4}{4}$; I., $\frac{3}{3}$; last molars well developed; canine teeth enlarged (with one or two roots). Vertebræ modified; axis with the spinous process enlarged; sacral four or five. Pelvis with the ischial tuberosities much prolonged backwards.

GYMNURINAE. (B.)

A. ERINACEINAE.

Genera.

Erinaceus, Linn.
  Erinaceus, Fitz., 1867.
  Hemiechinus, Fitz., 1867.
  Atelerix, Pomel, 1848,=Peroechinus, Fitz., 1867.

B. GYMNURINAE.

Genera.

Gymnura, Vigors and Horsfield, 1827,=Echinosorex, Blainv., 1838.
Hylomys, S. Müll. and Schlegel, 1843.

SORICOIDEA.

V. TALPIDAE.

SUBFAMILIES.

I. Skull with pterygoid region not inflated: with a distinct pterygoid fossa; with the lower jaw extended below under the ascending ramus. Teeth: I., $\frac{2}{2}$ or $\frac{2}{1}$. Sternum with a manubrium of moderate size. Fore limbs moderate and fitted for simple progression. Scapula with a metacromion process. Clavicle elongated. Humerus subcylindrical. Carpus with no sickle-shaped bone.
MYOGALINAE. (A.)

II. Skull with pterygoid region inflated; with no distinct pterygoid fossa; with the lower jaw contracted under the ascending ramus. Teeth: I., $\frac{3}{3-2}$. Sternum with the manubrium very elongated. Fore limbs enlarged and modified for digging. Scapula with no metacromion process. Clavicle short and broad. Humerus broad and enlarged at its angles. Carpus with an enlarged sickle-shaped bone.
TALPINAE. (B.)

A. TALPINAE.

Genera.

(Talpæ.*)

Talpa, Linn., 1758.†
Mogera, Pomel, 1848.‡
Parascaptor, Gill, 1875.§
Scaptochirus, A. Milne-Edwards, 1867.
Scaptonyx, A. Milne-Edwards, 1872.

(Condyluræ.)

Condylura, Illiger, 1811,=Astromycter, Harris, 1825,=Rhinaster, Wagler, 1830.

(Scalopes.)

Scalops, Cuvier, 1800=Talpasorex, Lesson, 1827, (not Schinz).
Scapanus, Pomel, 1848.||

B. MYOGALINAE.

Genera.

(Mygalæ.)

Desman, Lac, 1798, (fide Blainv.)=Mygale, Cuv., 1800 (not Latreille, 1802,),= Galemys, Kaup, 1829,=Mygale, Fischer, 1829,=Caprios, Wagler, 1830.
  Myogale, Gray.
  Galemys, Gray.

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* The genus *Talpa*, as adopted by most authors, seems to comprise three forms, which consistency to the principles in vogue among therologists entails differentiation into as many genera.

† Talpa.—Teeth: M., $\frac{3}{3}$; Pm., $\frac{4}{4}$; C., $\frac{1}{1}$; I., $\frac{3}{3}\times2$. Type *Talpa europæa.*

‡ Mogera.—Teeth: M., $\frac{3}{3}$; Pm., $\frac{4}{4}$; C., $\frac{1}{1}$; I., $\frac{3}{2}\times2$. Type *Talpa mogura.*

§ Parascaptor.—Teeth: M., $\frac{3}{3}$; Pm., $\frac{3}{3}$; C., $\frac{1}{1}$; I., $\frac{3}{3}\times2$. Type *Talpa leucura* Blyth.

|| "NOTA.—Ce troisième genre diffère des scalops par la position latérale et non supérieure de l'ouverture des narines, et par la formule dentaire comprenant une intermédiaire supérieure et trois inférieures de plus. Les espèces sont: *Scapanus Townsendii* et *Breweri* (*Scal. Townsendii* et *Breweri* Bachm.)."—Archives sc. phys. et nat., IX, 247, 1848.

(Urotrichi.)

Urotrichus, Temminck, 1842.
Uropsilus, A. Milne-Edwards, 1872.

VI. SORICIDAE.

Genera.

(*Fide* A. Milne-Edwards. *)

(Crocidurinæ.)

Anourosorex, A. Milne-Edwards, 1870.
Diplomesodon, Brandt,=Sorex *f* Crocidura § Diplomesodon, Wagner, 1855.
Crocidura, Wagler, 1832.=Sorex, Duv., 1834.
  Crocidura, Wagler,=Sorex *b*, Gray, 1837.=Junkus Ehr.=Leucodon, Fatio,=Musaraneus 3e section Crocidura, Pomel, 1848,=Sorex *f* Crocidura, Wagner, 1855.
  Myosorex, Gray, 1837, (Sorex varius, Smuts,)=Sorex 2e section Myosorex, Pomel, 1848.=Sorex *g* Myosorex, Wagner, 1855.
  Pachyura, Selys,=Galemys 3e section Pachyura, Pomel, 1848,=Feroculus, (Kelaart,) Wagner, 1855,=Sorex *d* Feroculus, Wagner, 1855.

(Soricinæ.)

Blarina, Gray, 1837,=Corsira, (Blarina,) Gray, 1837, (Sorex talpoides, Gapper,) =Anotus, Wagn., 1855,=Brachysorex, Duvernoy, 1842,=Musaraneus 1re section Cryptotis, Pomel, 1848,=Talpasorex, Pomel, 1848.
Sorex, (Linn., 1758,) Wagler, 1832,=Corsira, Gray, 1837,=Hydrosorex, Duv., 1834, (not 1836,)=Amphisorex, Duv., 1836, (not 1834).
  Sorex, Linn.=Sorex 2e section Corsira, Pomel, 1848,=Sorex c. Sorex, Wagner, 1855.
  Paradoxodon, Wagn., 1855,=Sorex c. Paradoxodon, Wagner, 1855.
  Soriculus, (Blyth,) Wagner, 1855,=Sorex b. Soriculus, Wagner, 1855.
  Otisorex, DeKay, 1842,=Sorex 3e section Otisorex, Pomel, 1848.

(Crossopinæ.)

Hydrogale, Pomel, 1848, †(provisional,)=Sorex 4e section Hydrogale, Pomel, 1848,=Neosorex, Baird.
Crossopus, Wagl., 1832,=Hydrosorex, Duv., 1836, (not 1834,)=Pinalia, Gray, (ex MSS.,) 1837,=Galemys 2e section Crossopus Pomel, 1848,=Sorex a. Crossopus, Wagner, 1855.
Nectogale, A. Milne-Edwards, 1870.

CENTETOIDEA.

VII. CENTETIDAE.

SUBFAMILIES.

1. Centetids with a squat form, rudimentary tail, and well-defined spines developed in pelage. Skull not constricted behind the orbits; with the squamosal bones expanded outwards and backwards. Teeth: Pm., $\frac{2-3}{2-3}$; I., $\frac{2-3}{2-3} \times 2$ (Pm., $\frac{3}{3}$; I., $\frac{3}{3}$; or Pm., $\frac{3}{3}$; I., $\frac{2}{3}$; or Pm., $\frac{3}{3}$; I., $\frac{2}{2}$; or Pm., $\frac{2}{2}$; I., $\frac{2}{2}$).—Peculiar to Madagascar.

CENTETINAE. (A.)

2. Centetids with a protracted form, elongated tail, and no distinct spines in pelage. Skull slightly constricted behind the orbits; with the squamosal bones expanded outwards and forwards. Teeth: Pm., $\frac{4}{4}$; I., $\frac{2}{2} \times 2$.—Peculiar to West Indies.

SOLENODONTINAE. (B.)

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* Recherches sur les mammifères, pp. 255–259, 1872. The groups ending in "inæ," named by Edwards, are not subfamilies, (nor even of the value of "groups,") as understood in this article.

† "4e section. *Hydrogale* Pom. Pieds frangés à longs poils; oreilles cachées par les poils, second lobe de l'incisive supérieure séparé en une dent distincte ; si ce caractère se confirmait, ce type pourrait être érigé en un genre distinct: *H. fimbripes*, l'espèce est le *sorex fimbripes* Bachm."—Archives des sc. phys. et nat., IX, 248, 1848.

This genus is undoubtedly congeneric with *Neosorex*, Baird, and includes at least two species, viz: (1) *Hydrogale palustris*=*Sorex palustris*, Rich.; (with which *Sorex fimbripes*, Bachman, notwithstanding the discrepencies between the descriptions, is perhaps identical,) and (2) *Hydrogale navigator*=*Neosorex navigator*, Baird.

A. CENTETINAE.

Genera.

Tenrec, Lac., 1798,=Centetes, Illiger, 1811,=Setiger, I. Geoff. St.-Hil., 1820,= Centenes, Desm., 1820,=Eteocles, Gray, 1821.
Echinodes, Pomel, 1849, (not characterized,)=Hemicentetes, Mivart, 1871,= Ericius, Giebel, 1871.
Ericulus, I. Geoff. St.-Hil., 1839.
Echinops, Martin, 1838, (not Linn.)=Echinogale, A. Wagner, 1840.
? Geogale, A. Milne-Edwards, 1872.

B. SOLENODONTINAE.

Genus.

Solenodon, Brandt, 1833.

VIII. POTAMOGALIDAE.

Genera.

Potamogale,* Du Chaillu, 1860, (provisional genus proposed for Cynogale velox, Du Chaillu,)=Mythomys, Gray, 1861,=Potamogale, Allman, 1863,=Bayonia, Barbosa du Bocage, 1865.

CHRYSOCHLOROIDEA.

IX. CHRYSOCHLORIDAE.

Genera.

Chrysochloris, Lac., 1798.=Aspalax, Wagler, (not Oliv. Desm.)
Amblysomus, Pomel, 1848,†=Chalcochloris, Mivart, 1867.

M. Grandidier (Rev. et Mag. Zool., 1871, p. 50) has given a description of an Insectivore (*Oryzorictes hova*), translated in part in "The Zoological for in 1870," (p. 9); but insufficient data are given for the determination of its relations, and the number of the volume containing the original description is not at hand.

*Animal, Allman, Tr. Zool. Soc., VI, pl. 1,+figs. 1–5. Skeleton, Allman, Tr. Zool. Soc., VI, pl. 2. Skul, Allman, Tr. Zool. Soc., VI, figs. 6 (above), 7 (below), 8 (lower jaw and its teeth). Intestinal canal, Allman, Tr. Zool. Soc., VI, fig. 9 (terminal portion).

†"Genre *Chrysochlora.* (Il y a un sous-type ayant une molaire de moins à chaque mâchoire, et dépourvu de la bulle osseuse de la tempe qui, chez les autres, fait partie de l'oreille interne ainsi soulevée en dedans. *Amblysomus.*)"—Archives sc. phys. et. nat., IX, 247, 1848.

APPENDIX.

Pending the publication of a revised monograph of the insectivores of the United States (which will probably be soon undertaken in part at least by Dr. Elliott Coues), a list of those works in which the most reliable information respecting various species may be found will perhaps be acceptable. In addition to the works already cited in the foot-notes to the preceding paper, the following will be the most serviceable, and therein references to various other sources of information can be found.

The distinctive characters of the families Soricidæ and Talpidæ—the only ones represented in the North American fauna—are also contrasted in detail in parallel columns, and their common characters extended across their respective columns.

The tables thus given are extracted from the series prepared to bring the points of agreement and disagreement of the several families of Insectivora into more prominent relief.

So far as the Soricidæ are concerned, the characters common to all their known members might be extended almost indefinitely; but within the limits of the family Talpidæ, as here accepted, the range of variation is much more considerable, and the purpose here being simply to exhibit those characters in which all the members of one family differ from all those of the other, the features not answering for this purpose are eliminated from the comparison. It is probable, however, that the contrast might be extended considerably more than has now been done, but there are several genera which have not yet been described in sufficient detail to permit a more extended exhibition of the common characters to be given.

The descriptions thus contrasted have been generalized from a comparison of skeletons and skulls of the American and European types of the superfamily. The only genus of the Talpidæ so represented of which I have not been able to examine the skeleton is *Urotrichus*; of that form I have only had the opportunity of seeing the very imperfect skull which nearly twenty years ago served Professor Baird as the type of his *Urotrichus Gibbsii*, the attempts since made to obtain other examples of the species not having been successful.

At the same time, it must not be disguised that the differential characters offered by the two families here distinguished are very numerous and salient, and the common characters comparatively few. It may therefore be an open question whether the two should not be elevated to the rank of "superfamilies" ("*Soricoidea*" and "*Talpoidea*"): the writer will only urge in favor of the valuation here assigned, the apparent closer unity between the two than between either and any other family of insectivores and the importance and significance of the common characters furnished by the agreement in the structure of the molar teeth; from the *point d'appui* thus secured, the appreciation of the respective characters of the two groups seems to be facilitated, and though the differences are many the agreements are more numerous than in comparison with any other form, and are likewise supported by coincidences which may be of little account by themselves, but in the aggregate become quite significant.

If, on the other hand, the members of either family are compared with those of others here admitted, which have been combined with them, the differences will be found to be much more radical, and this remark applies in the highest degree to the two forms respecting which the old and superficial ideas are most persistent, that is, the Talpidæ and Chrysochloridæ. The external similarity as to form in these groups is great. The osteological and dental differences are greater than between any other forms of the suborder Bestiæ.

I.—CONTRASTED CHARACTERS OF SORICIDÆ AND TALPIDÆ.

SKULL.

(*Teeth.*)

SORICIDÆ.	TALPIDÆ.
Teeth of upper jaw: M. 3, Pm. 1–2, C. 1, I. 2–4 × 2;	Teeth of upper jaw: M. 3, Pm. 3–5, C. 1, I. 2–3 × 2;

true molars mostly—*i. e.*, M. 1 and M. 2—with four primary (but generally reduced to three by coalescence of the median) *external* and two primary and more elevated *internal* cusps; the outer and inner connected together by oblique ridges, and thus circumscribing two re-entering triangular areas pointed inwards; with an internal ledge bearing a cusp along its inner wall;

SORICIDÆ.	TALPIDÆ.
also with a well-developed secondary lower ledge behind the principal internal one.	but with no (well-developed) secondary lower ledge behind the principal internal one.
Teeth of lower jaw: M. 3, Pm. 1–2, C. 1, I. 1 × 2. True molars with two primary external cusps—*i. e.*, anterior and posterior—and four primary internal cusps—*i. e.*, an anterior, two median—(the postero-median sometimes coalescent with the antero-median), and a posterior;	Teeth of lower jaw: M. 3, Pm. 3–5, C. 1, I. 3–1 × 2. True molars with two primary external cusps—*i. e.*, anterior and posterior—and three primary internal cusps—*i. e.*, an anterior, an antero-median—(the postero-median being suppressed), and a posterior;
the antero-external cusp connected with the anterior and antero-median internal by ridges, and thus circumscribing a triangular area;	the antero-external cusp connected with the anterior and antero-median internal by ridges, and thus describing a triangular area;
the postero-external cusp connected with the posterior internal cusp and with the ridge near and from the antero-internal to the median internal cusp, thus defining a trapezoidal area:	the postero-external cusp connected with the posterior internal as well as with the median or postero-median internal by ridges, and thus circumscribing a triangular area:

Premolars, canines, and incisors varying greatly among the Talpidæ, but little among the Soricidæ.

SORICIDÆ.	TALPIDÆ.

(*Cranial bones.*)

Cranium with the contour conoid, contracted between the orbits;

calvarium oblong-ovate and depressed (mostly with vacuities between the occipital and periotic elements);

SORICIDÆ.	TALPIDÆ.
lambdoidal and sagittal ridges well defined (lambdoidal confluent with the post-glenoid process of the squamosal);	lambdoidal and sagittal ridges quite obsolete;
occiput inclined forwards, and with no median protuberance above the foramen magnum;	occiput curved forwards, and with a median vertical protuberance above the foramen magnum;
occipital condyles strongly converging;	occipital condyles slightly converging;
foramen magnum extending little forwards;	foramen magnum extending far forwards;
occipito-sphenoid bones narrowed between periotic regions;	occipito-sphenoid bones widened between periotic regions;
large apertures at the base of the skull;	no apertures at the base of the skull;

mesopterygoid fossa not continued backwards in an excavation of the basis cranii;

SORICIDÆ.	TALPIDÆ.
tympanic bone loosely connecting with the contiguous bones, annular, and no bulla developed;	tympanic bone united with the contiguous bones, (irregular,) and a bulla thereby developed;

paroccipital process none;

SORICIDÆ.	TALPIDÆ.
mastoid process developed;	mastoid process, none;
post-glenoid process of squamosal very large;	post-glenoid process of squamosal undeveloped;
supra-orbital and supra-temporal roof developed, continuous, and therefore no post-orbital process differentiated;	supra-orbital and supra-temporal roof obsolete, and no post-orbital process developed;
glenoid surface an extensive oblique furrow, (extending downwards and inwards,) with well-excavated sockets at the extremities, and bounded by well-developed antero-verted post-glenoid processes;	glenoid surface high up and very small and superficial, and bounded by no post-glenoid processes;
zygomatic arch undeveloped.	zygomatic process a slender rod.

Soricidae.	Talpidae.

(Cranial foramina.)

Soricidae.	Talpidae.
Ante-orbital foramen covered in by a wide wall, very contracted at anterior entrance, and pocket-like in front of orbit;	Ante-orbital foramen arched over by an oblique thread-like bridge, and very open;

foramen rotundum and sphenoidal fissures confluent in a single vacuity;

carotid foramen developed;

glenoid foramen none;

alisphenoid canal none.

(Lower jaw.)

Soricidae.	Talpidae.
Horizontal rami short and stout; ascending rami diverted outwards and stout; the condyles directed obliquely inwards and forwards, and ending at the internal ends in acute tubercles;	Horizontal rami elongated and slender; ascending rami almost erect and thin; the condyles produced backwards, and developed as small transerve knobs;
the coronoid processes stout, and each with a pocket-like cavity at the base.	the coronoid processes small, and with no cavities at their bases.

VERTEBRÆ.

Vertebræ: *d.* 12 – 15 + *l.* 5 – 7 (=19–20) + *s.* 5 – 6.

Soricidae.	Talpidae.
cervical with neurapophyses very rudimentary; with hypapophyses well developed;	cervical with neurapophyses narrow antero-posteriorly; with hypapophyses obsolete;
dorsal with very small or (in front) obsolete spinous processes;	dorsal (except last 3 or 4) with small spinous processes;

with well-developed antero-lateral processes;

Soricidae.	Talpidae.
hyperapophyses well developed;	hyperapophyses obsolete;
lumbar with no hypapophysial ossicles.	lumbar with autogenous hypapophysial ossicles (beneath their interspaces).

FORE LIMB AND APPENDAGES.

(Scapula.)

Soricidae.	Talpidae.
Scapula rather short and broad, with its distal margin obliquely truncated, but with rounded angles.	Scapula very long and narrow, with its distal portion abruptly enlarged and more or less clavate.

(Clavicle.)

Soricidae.	Talpidae.
Clavicle quite long, slender, and simply arched (nearly uniform in all the genera examined).	Clavicle more or less short, robust, and quite straight (varying greatly otherwise in the several forms).

(*Sternum.*)

Sternum with manubrium widest towards the front and not at all keeled;	Sternum with manubrium widest near the middle and more or less keeled;

with sternebers narrow, and carinate or elevated at the middle.

(*Fore limb.*)

Fore limbs varying greatly, modified more or less in accordance with the more or less fossorial adaptation in the various genera, their primary modifications differentiating into subfamilies (see *Talpinæ* and *Myogalinæ*); radius and ulna always separate; digits five:

carpus with no os intermedium.	carpus with an os intermedium.

HIND LIMB AND APPENDAGES.

(*Pelvis.*)

Pelvis very long and narrow; the ossa innominata parallel with the vertebral column; the ilia very narrow and anchylosed with the sacrum; the ischia and pubis parallel, inclosing narrow thyroid foramina, and produced towards their inferior posterior angles; the pubes more or less widely diverging and separated from each other;

pubes distant in front.	pubes approximated in front.

(*Hind limb.*)

Femur robust, straight, with a large trochanter nearly as terminal as the articular head, and with a smaller one lower down and near the tuberosities of the distal extremities subequal:

tibia and fibula wide apart below their heads for the proximal third or half of their length, and soldered together at their distal portions;

tibia more or less sigmoidally curved, with its proximal portion compressed; with an anterior triangular, flattened surface widening towards its head, and with an external apophysis or hook;

fibula nearly straight, and towards its proximal end sending out crests terminating in hooks or tubercles.

Pes normally developed; tarsus with the seven ossicles regularly proportioned to each other; calcaneum with an interno-distal apophysis; astragalus with the articular concavities on the same axis; scaphoid moderate, normally excavated for the astragalus, and with a large surface of attachment for the cuboid; cuboid elongated; cuneiforms more or less subequally developed, oblong, and parallel.

Digits five, normally related to each other.

VISCERA.

Intestinal canal with no cæcal diverticulum.

EXTERNAL FEATURES.

Pelage with fine and soft hair or fur.

II.—BIBLIOGRAPHY.

GENERAL WORKS.

Harlan (Richard, M. D.) Fauna Americana: being a description of the mammiferous animals inhabiting North America. Philadelphia: published by Anthony Finley. J. Harding, printer. 1825. [8vo, 318 pp. 1 l.]

Dr. Harlan admitted in the "Family Insectivora" (p. 24) four genera and ten species, viz:—

Sorex (p. 24), 4 sp.
Scalops (p. 30), 2 sp. (= 1 sp.).
Condylura (34), 3 sp. (= 1 sp.).
Talpa (p. 41), 1 sp. (erroneously introduced).

The *Talpa Europea*, Lin., was admitted, without the slightest criticism or comment, into the American fauna solely on the authority of the record of a mole ("*Talpa americana*, black mole, Bartram's manuscript, notes," *fide* Harlan, p. 43) in a diary, or "a calendar of natural history," kept by William Bartram, and which was, as Harlan said, "never intended for publication." Doubtless, Bartram had reference simply to the common mole of Philadelphia (*Scalops aquaticus*). Harlan's description was adapted from Desmarest. Nevertheless, a recent uncritical European writer (Dr. J. L. Fitzinger) has attributed a species to this country, nothwithstanding its repudiation by all other authors.

Godman (John D., M. D.) American natural history.
Volume I[-]Volume II. Part I.—Mastology.—Philadelphia: H. C. Carey & I. Lea—Chestnut-street, R. Wright, printer. 1826. [8vo, volume I, eng. title, XVI+17–362 pp., 21 pl.; volume II, eng. title, 331 pp., 19 pl.]
Volume III. Part I.—Mastology.—Philadelphia: Carey, Lea & Carey—Chestnut street. 1828. [Eng. title, 264 pp., 9 pl.]

Three editions of this work have been published, the last being in a single volume.

Dr. Godman has recognized, in the "Family II (of Feræ).—Insectivora" (p. 73), three genera and five species, viz:—

Sorex (p. 74), 3 sp.
Scalops (p. 81), 1 sp.
Condylura (p. 97), 1 sp.

Audubon (John James) and John Bachman. The Viviparous Quadrupeds of North America. . . . .
Vol. I. New-York: published by J. J. Audubon. MDCCCXLVI. [xiv, (1,) 389 pp; pl. 1–50.]
Vol. II. New-York: published by V. G. Audubon. MDCCCLI. [Title, 334 pp., 1 l.; pl. 51–100.
Volume III. New York: published by V. G. Audubon. 1854. [1 p. l., v, 348 pp., 1 l.; pl 101–155.—Entitled, "The Quadrupeds of North America."]

The authors, in the several volumes of their work (no systematic arrangement having been followed), admitted three genera and eighteen species, viz:—

Sorex parvus, II, 145 (Bd. 56: doubtful).
carolinensis, II, 176 (Bd. 45: *Blarina carolinensis*).
palustris, III, 108 (Bd. 55: doubtful).
Dekayi, III, 246 (Bd. 36: *Blarina talpoides*).
longirostris, III, 249 (Bd. 30: *Sorex personatus*).
Forsteri, III, 310 (Bd. 22).
Cooperi, III, 311 (Bd. 27).
fimbripes, III, 312 (Bd. 55: doubtful).
personatus, III, 314 (Bd. 30).
Richardsonii, III, 334 (Bd. 24).
brevicaudus, III, 331 (Bd. 42: *Blarina brevicauda*).
Scalops aquaticus, I, 81 (Bd. 60).
Breweri, II, 173 (Bd. 68: *S.* (*Scapanus*) *Breweri*).
Townsendii, III, 217 (Bd. 65: *S.* (*Scapanus*) *Townsendii*).
argentatus, III, 252 (Bd. 63).
æneus, III, 321 (Bd. 65: *S.* (*Scapanus*) *Townsendii*).
latimanus, III, 323 (Bd. 65: doubtful).
Condylura cristata, II, 139 (Bd. 71).

Baird (Spencer Fullerton). Mammals of North America; the descriptions of species based chiefly on the collections in the Museum of the Smithsonian Institution. . . . . With

eighty-seven plates of original figures, illustrating the genera and species, and including details of external form and osteology. Philadelphia: J. B. Lippincott & Co., 1859. [4to, 4 p. l., xi–xxxiv, 735 pp. + (part II, 1–55 pp.), 736–764 pp., 87 pl. (29 col.)—$10; with col. pl. $15.]

Prof. Baird recognized the following groups and number of species:—

	Admitted.		Doubtful.	
Soricidæ:—				
Neosorex (p. 11)	1			(1 new).
Sorex (p. 13)	12	+	4	(7 new).
Blarina (p. 36)	7			(3 new).
Talpidæ:—				
Scalops { Scalops (p. 58)	2			
Scalops { Scapanus (p. 58	2	+	1	
Condylura (p. 71)	1			
Urotrichus (p. 76)	1			(1 new).

Allen (J. A.) Catalogue of the mammals of Massachusetts; with a critical revision of the species. < Bull. Mus. Comp. Zool., I, No. 8 = pp. 143–252, 1 l., 1869.

Mr. Allen has greatly reduced the number of species admitted by his predecessors, and has only recognized seven as inhabitants of Massachusetts, viz:—

Soricidæ:—
Neosorex (p. 211), 1 = Sorex, doubtful sp. of Baird.
Sorex (p. 212), 3 + 1 = 4 sp. of Baird.
Blarina, 1 = 7 sp, of Baird.
Scalops, 2 = 2 sp. of Baird.

The following article, although more fragmentary and of less general interest than the preceding, is noteworthy as containing the original descriptions of several of the best known American insectivores:—

Gapper (Dr. —). Observations on the quadrupeds found in the district of Upper Canada extending between York and Lake Simcoe, with the view of illustrating their geographical distribution as well as of describing some species hitherto unnoticed. < Zool. Journ. V, 201–207, 1830.

Contains description and figure of the *Sorex talpoides*.

Sorex Forsteri (p. 201, pl. 7 = Sorex platyrhinus, Baird), Sorex talpoides, n. sp. (p. 208, pl. 8 = Blarina talpoides, Baird, Allen).

Gilpin (J. Bernard). On the mammalia of Nova Scotia. No. II. [Talpidae, Vespertilionidæ, Felidæ, Canidæ.] < Trans. Nova Scotian Inst. Nat. Sc. (Hal.), II, part III, art. 1=pp. 8–15, 1864.

TALPIDÆ.*

TALPINÆ.

Scalopes.

Barrington (Daines). Account of a mole [Scalops?] from North America: In a letter to Dr. Maty, sec. R. S., from the Hon. Daines Barrington, F. R. S. <Philos Trans. Royal Soc. Lond., LXI, art. xxxiv = pp. 292–293, 1771.

Woodruff (Samuel). The mole (Scalops Canadensis, Cuv.) carnivorous. <Am. Jour. Sc. & Arts, xxviii, 168–171, 1835.

Bachman (J.) Observations on the genus Scalops, (shrew moles,) with descriptions of the species found in North America. <(Abstract) Proc. Boston Soc. Nat. Hist., I, 40–41; 1841; (in full) Boston Jour. Nat. Hist., IV, No. 1, art. III = pp. 26–35, Jan. 1842.

Cassin (John). [Remarks on a new species of *Scalops—S. metallescens*—from Oregon.] <Proc. Acad. Nat. Sc. VI, 242, 1853.
Not described.

Le Conte (John). [Remarks on the specimens of *Scalops* in the collection of the academy.] <Proc. Acad. Nat. Sc. Phila., VI, 326–327, 1853.

Kennicott (Robert). Zoology of Illinois. The silvery shrew mole, or ground mole of Illinois—Scalops argentatus, Aud. & Bach. <The Prairie Farmer, XVI, No. 50, Dec. 11, 1856.

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*The following articles are also noteworthy:—

Rédarès (M.) Manuels Roret.—Le chasseur taupier ou l'art de prendre les taupes [talpa] par des moyens surs et faciles; précédé de leur histoire naturelle . . . . Nouvelle édition, augmentée d'un traité sur la destruction des animaux et des insectes nuisibles au jardinage. Ouvrage orné de figures. Paris, la librairie encyclopédique de Roret, . . . 1850. [18mo, 83 pp. 2 pl.]

Eimer (Dr. Th.) Die Schnautze des Maulwurfs [Talpa] als Tastwerkzeug. <Archiv. für mikrosk. Anat., VII, 181–191, pl. 17, 1872.

Giebel (C. G.) Osteologische Eigenthümlichkeiten des nordamerikanischen Wassermulls (Scalopus aquaticus). <Zeitschr. gesammt. Naturw. Halle, XII, 395–405, 1858.

Fowler (Augustus). Woodcock and moles. <Am. Nat., IV, p. 761, 1871.

Peters (W.) Über neue Eichhornarten [Sciuridæ] aus Mexico, Costa Rica und Guiana, so wie über *Scalops latimanus* Bachmann. <Monatsb. K. Pr. Akad. Wissensch. Berlin, 1863, 652–656.

Scalops latimanus (Bachman's type in Berlin Museum) = *Sc. Townsendi* Bachman, Baird (p. 656)."

Condyluræ.

Godman (J. D.) Note on the genus Condylura of Illiger. <Jour. Acad. Nat. Sc. Phila., V, 109–116, 1825.

Harris (T. W.) Description of a nondescript species of the genus Condylura (C. prasinata) <Boston Jour. Phil. II, 580–583, 1825; Phil. Mag. (Tilloch's), LXVII, 191–193, 1826.

Billings (E.) On the star-nosed mole [*Condylura cristata*] of America. [anon.] <Can. Nat. and Geol., II, art. XXXVIII = pp. 446–448, 1857.

Tenney (Sanborn). The star-nosed mole. <Am. Nat., V, p. 314, 1871.

Note.—Respecting its appearance in winter.

MYGALINÆ.

Lord (J. K.) Notes on the Urotrichus. <Proc. Zool. Soc. London, 1864, pp. 161–163.

SORICIDÆ.†

Bachman (J.) Some remarks on the genus *Sorex* with a monograph of the North American species. <Jour. Acad. Nat. Sc. Phila., VII, 362–402, pl. 23–24, 1837.

Linsley (James H.) Sorex parvus and Sorex brevicaudis. <Am. Jour. Sc. & Arts, XXXIX, 388–389, 1840.

Cope (E. D.) On Neosorex albibarbis. <Proc. Acad. Nat. Sc. Phila., 1862, 188–189.

Verrill (A. E.) List of the species of the family Soricidæ, known to inhabit New England. <Proc. Boston Soc. Nat. Hist., X, 172–173, 1862.

Verrill (A. E.) Notice of a species of Neosorex from Massachusetts, and of Sorex Thompsoni from Maine. <Proc. Boston Soc. Nat. Hist., IX, 164–172, 1862.

Verrill (A. E.) [Supplementary notice of Neosorex palustris.] <Proc. Boston Soc. Nat. Hist., IX, 225–226, 1863.

Gilpin (J. Bernard). Soricinæ of Nova Scotia. [On the mammalia of Nova Scotia, No. I.] <Trans. Nova Scotian Inst. Nat. Sc. (Hal.), II, part II, art. I = pp. 1–4, 1863.

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†The following articles contain important information on collateral questions:—

Geoffroy St. Hilaire (Étienne). Sur les espèces des genres Musaraigne et Mygale. <Annal. Mus. Hist. Nat Paris, XVII, pp. 169–194, 1811.

Geoffroy St. Hilaire (Étienne). Mémoire sur les glandes odoriférantes des Musaraignes. <Annal. Mus. Hist. Nat. Paris, I, 1815, pp. 299–311.

Geoffroy St. Hilaire (Isidore). Mémoire sur quelques espèces nouvelles ou peu connues du genre Musaraigne. [1826.] <Mém. Mus. Hist. Nat. Paris, XV, 1827, pp. 117–144.

Duvernoy (G. L.) Fragmens d'histoire naturelle sur le genre Musaraigne (Sorex). <L'Institut, II, No. 70, 299, 1834.—Suite ibid., VI, No. 226, 111–112, 1838.—Isis, 1836, pp. 235–236. 1839. pp. 360–362.

Sundevall (Carl J.) Om slägtet Sorex, med några nya arters beskrifning. <K. Sv. Vet. Akad. Handl. (Stockholm), 1842, pp. 163–188.

REPORT ON THE NATURAL HISTORY OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, 1874.

By Ernest Ingersoll, Zoölogist.

Cambridge, Mass., *March* 1, 1875.

Sir: I herewith submit the subjoined report of zoölogical work done during the season of 1874 in connection with the survey under your charge, and have the honor to be, with the highest respect, yours, &c.,

ERNEST INGERSOLL,
Zoölogist.

Dr. F. V. Hayden,
U. S. Geologist, Washington, D. C.

The material herein reported upon is a collection, chiefly of mollusks, made by the writer, in connection with the photographic division of the survey, during the months of July, August, and September, 1874. I was assisted by Master Frank Smart, of Washington.

Our route lay from Denver west into Middle Park, thence south up the valley of the Blue to Hoosier Pass, leading us into South Park, from which we crossed over to the Arkansas, and thence through Poncha Pass into San Luis Park, and across to Saguache. From here the road was west to the Los Pinos Indian agency, and then southwest through Antelope Park to Baker's Park, in the high mountains.

At this point the camp was stationed; and leaving Mr. Smart to collect here, I accompanied Mr. Jackson on a side-trip of nearly three weeks' duration, made southwest into the valley of the Rio San Juan, at the extreme corner of the Territory. On our return trip from Baker's Park, we followed the Rio Grande to Del Norte, thence struck across the San Luis plain to the "sand-hills," through Musca Pass, Huerfano Park, Wet Mountain Valley, and Oak Creek, and finally came to Cañon City, where I left the party.

Collections were made at nearly every camp on the whole route, and that they do not make a greater aggregate is due to the inexperience of the writer, the short time he was in the field, the haste with which the party moved, and not a little to the comparative scarcity of those objects in which he happened to take the most interest, and most desired to have completely represented. In such cases, in the absence of specimens or affirmative evidence, he is able to show a certain amount of negative evidence, which may be of value in future deductions.

I append a list of the localities, remarking upon elevation and so forth, at which collections were made. The absence of any camp, as Nos. 12–16, from this list does not necessarily imply that I was idle, but that nothing of importance reached home from that locality.

LIST OF LOCALITIES FROM WHICH SPECIMENS WERE BROUGHT HOME.

CAMP 9: *Hot Sulphur Springs, Middle Park*, July 31 to August 5. Elevation 7,600 feet. A broad, open valley, containing hot and cold springs of various mineral waters.

CAMP 9–10: *Grand River Valley*, August 5. About 7,500 feet. Grassy prairies and river-terraces of coarse gravel covered with sage-brush, with but little timber, except along some portions of the river-banks.

CAMP 10: *Mouth of Blue River*, August 6–8. About 7,500 feet. High river-terraces. Cottonwoods and alders along the river and about springs in the neighboring hills.

CAMP 10–11: *Blue River Valley*, August 8. 7,500–8,500 feet. Same general characteristics as above.

CAMP 11: *Ute Peak, Blue River Valley*, August 8. 8,500 feet. Springy ground by a cold streamlet, with abundance of small timber and luxuriant herbage. Many shells were collected on a wooded hill 2,000 feet higher than the camp.

CAMP 17: *Head of San Luis Valley*, August 14. 7,600 feet. Luxuriant grass and herbage; large pines and spruces. Water in plenty.

CAMP 17–18: *San Luis Valley*, August 15. 7,600–7,200 feet. Distance thirty miles, mostly *Artemesia* plains, very dry and dusty. The weather, which had been rainy, now began to be clearer, with hot noondays and cool nights.

CAMP 18: *Springs, Saguache*, August 16. About 7,200 feet. Edge of dry plains. The springs come copiously from under a volcanic bluff, and flow into a marsh, which drains into Saguache Creek.

CAMP 19: *Saguache Creek*, August 16. Five miles beyond, on the banks of the above stream, which is a tributary of the Rio Grande, and waters a fertile region. Thousands of cattle are herded hereabouts.

CAMP 20: *Twenty miles west of Saguache*, August 17. 9,000 feet. Volcanic cañon.

CAMP 21: *Los Pinos Indian Agency*, August 19–24. 9,000 feet. A fertile plain watered by two creeks, and surrounded by hills, affording plenty of rain. The camp was placed among a grove of various trees by a little rocky stream. We remained a week at this point; but my time was largely occupied in studying the traits of the Ute Indians, whose agency is here.

CAMP 22: *South of Los Pinos*, August 24. 8,100 feet. A deep ravine, which had been recently burned over. Rainy.

CAMP 23: *Timber-line; divide between the Gunnison and Rio Grande*, August 25. 9,200 feet. Timber mostly small; no pines. Found many mollusks in the deep wet grass early in the morning.

CAMP 24: *White-earth River*, August 26. 8,300 feet. A tributary of the Rio Grande, emptying in Antelope Park. The banks were here covered with a riotous growth of brush and weeds.

CAMP 25: *Jennison's Ranch*, August 27–28. 9,300 feet. On the Rio Grande, between Antelope and Baker's Parks. Fertile alluvial bottoms, with plenty of timber on the hills. Clear, with frosty nights.

CAMP 26: *Howardsville, Baker's Park*, August 29–September 23. 9,300 feet. A deep valley among immense trachyte mountains. Abundance of timber (spruce and the like and aspen), bushes and plants. Frosty nights, and snow toward the last of our stay.

Cunningham Gulch is a deep cañon near by, on the high, perpendicular side of which, along trails leading to silver-mines, I found active mollusks and insects at an altitude of fully 11,000 feet.

CAMP D: *Head of the Animas Valley*, September 3. 8,100 feet. Southern slope of high sierras. A beautiful region in all respects. This and the four following localities were in the side-trip into the San Juan Valley.

CAMP E: *Animas Park*, September 4. 6,350 feet. Lower down the river, where the broad bottoms are somewhat cultivated.

CAMP E–F: *Between the Rio Animas and Rio La Plata*, September 4. 7,000 feet. Half-way we passed a great pond, surrounded with rushes; the resort of innumerable wild fowl, and inhabited by a great variety of fresh-water life.

CAMP F: *Rio La Plata Mining Camp*, September 5–8. 7,200 feet. Collections made in dense damp groves of evergreen and deciduous trees.

CAMP K: *Hovvenweep, Utah*, September 13. 4,500 feet. A low, dry ravine some twenty miles into Utah, in a desolate *mesa* country, named by us Hovvenweep, from two Indian words meaning deserted cañon. It furnished only gnarled cedars, sage-brush, and greasewood. The valley must be subject to floods.

CAMP P: *Head of Mineral Creek*, September 19. 9,300 feet. The sources of a mountain-torrent draining into Baker's Park.

CAMP 28–29: *Saint Mary's Lake, Antelope Park*, September 25. 8,300 feet. A beautiful lake without inlet or outlet, on the eastern side of the park, surrounded by rocky cliffs. Inhabited by some peculiar shells and hosts of water-fowl, while its shores are the resort of large herds of antelope.

CAMP 30: *Rio Grande above Del Norte*, September 28. 7,560 feet. The camp was in a low spot by a sluggish stream.

CAMP 32: *Lakes, San Luis Valley*, September 29. 7,500 feet. These lakes are, most of them, dry in September, and all the shells I found were dead on the beach. They are frequented by innumerable wild geese and ducks, which are tormented by the many large gulls which make the lakes their home. The waters are alkaline, and the whole region is white with saline deposits and nearly barren.

It will be observed that all of these localities are in Colorado, except Camp K.

GENERAL ACCOUNT OF THE WORK.

Attention was given to fresh-water invertebrate life, though the results were not very satisfactory.

At the springs near Saguache, leeches were found, pronounced by Prof. A. E. Verrill to be *Aulostomum lacustre*, var. *tigris*, Verrill, and *Clepsine modesta*, Verrill, both of which have been found heretofore in the same region. A more thorough search, had it been possible, would probably have revealed additional forms, as the locality was extremely favorable.

For crustacea a sharp lookout was kept, but only the following species were certainly seen: two amphipods, *Gammarus robustus*, Smith, and *Hyallela inermis*, Smith, both of which were described in the Report for 1873, which inhabited the above springs in great abundance. From the pond mentioned between camps E and F a small crab was brought home, which Prof. S. I. Smith pronounced to be a true marine form, belonging to the *Astacidæ*. That this is a survivor of the period, probably comparatively recent, when this pond was a salt-water marsh, is supported by the fact that well-preserved fragments of *Arca* shell were found on the muddy shores.

The insects were not methodically collected, and but few, chiefly myriapods, which are very abundant in the mountains, were brought home. A small collection of spiders made consists of ten species of ARANEÆ (*Drassidæ* 2, *Lycosa* 5, *Attus* 1, *Thomisus* 2); and four species of PHALANGEÆ (*Phalangein* 3, *Gonyleptes* 1). All of these species are believed by Mr. E. H. Emerton, who has examined them, to be undescribed, though in part identical with forms previously collected in Colorado. A description is not attempted herewith, because the material is not at hand for proper study and comparison. Further collections and observation in this branch of entomology are particularly desirable from the mountainous regions of all the Territories.

Land and fresh-water shells comprise the largest part of the material brought home. They were made a specialty; and the fact that next to nothing of this class had ever been reported from Colorado, and but little was known at all of the mollusca of the Rocky Mountain region, was deemed a sufficient excuse for what might seem too exclusive attention to this department of natural history, which does not present to the careless mind such striking attractions as the study of the higher vertebrates.

No fishes were collected, although numerous attempts were made. The majority of our time was spent where they seemed to be entirely absent, or so extremely scarce that, although all were interested in the capture of certain species, not a trout graced our table during the whole trip.

Some snakes and frogs were secured at Hot Springs, Middle Park, and a number of *Amblystoma* seen for the first and last time. Reptiles were taken wherever they occurred after this, also, except upon the long side-trip mentioned above, where it was impracticable to preserve anything greater than could be put in a pocket-bottle of alcohol. The marsh between the Animas and La Plata was a fine locality for batrachians. South of the mountains, lizards began to appear in great numbers and variety, and increased as we got farther out upon the dry plains. Camp 20 furnished us our only rattlesnake, and I do not remember any other camp at which we were even suspicious of their presence.

In conclusion, I wish to express to Mr. Wm. H. Jackson, director of our party, the appreciation I have of his hearty co-operation and genial sympathy, through which he not only afforded me opportunities I would not otherwise have had, but added immensely to my personal enjoyment of this delightful trip.

SPECIAL REPORT ON THE MOLLUSCA.

BY ERNEST INGERSOLL, ZOÖLOGIST.

The collection of mollusks fairly represents the land and fresh-water families, and comprises many additions to the fauna of Colorado, as well as the following six species, believed to be new:

Limax montanus, Ingersoll.
Limax castaneus, Ingersoll.
Microphysa Ingersollii, Bland.
Pupilla alticola, Ingersoll.
Helisoma plexata, Ingersoll.

With respect to their distribution: it will be seen that none were found on the eastern slope of the range, although there is no conclusive evidence that they do not exist there; that there was a marked increase as we advanced south; that altitude seemed to have little influence upon their range so long as other favorable conditions were present; and that some species (as of *Helisoma*) had a very local distribution. The genera *Zonites*, *Vitrina*, *Vallonia*, *Pupa*, and *Succinea* were wide-spread. Among the Helices, *Patula Cooperi* only occurred in broad open valleys; *Patula striatella* and *Cronkhitei* were found together over the northern portion of the district traversed, but in the south the latter replaces *striatella*. The little *Microphysa* was not found north of the Saguache range, though occurring abundantly on the cliffs in Baker's Park up to 11,000 feet, and also in the Animas and other valleys draining into the Rio San Juan. All the other species of this genus belong to Florida and the Gulf coast. The *Pupæ* were perhaps the most common forms, increasing as we went south, where specimens of *Vertigo californica* and *Pupilla alticola* were numerous everywhere on the mountains as high up as timber grows.

In order to make this list as far as practicable a statement of our present knowledge of the mollusca of that portion of the United States lying between the Rocky Mountains on the east and the Sierra Nevada on the west, designated by Mr. W. G. Binney the *Central Province* (Bulletin Mus. Comp. Zoöl., III, IX), I have inserted in their proper systematic place such mollusks as I could ascertain to have occurred within that region, distinguishing those species which form my own list by the black head-letter type.

There seems some reason to doubt whether the limits assigned by Mr. Binney in his Geographical Catalogue, above referred to, circumscribe a true zoölogical province, considered with reference to the mollusca; but I have contented myself with carefully tabulating such observations as I have access to, leaving to others such deductions as the facts may warrant.

Enough is present, however, it seems to me, to show that the Central Province, so-called, is not so deficient as has been supposed, either in

the number of species, or in representatives of adjoining faunas. The impression that this inter-montanic region is unfavorable to the development of pulmonates also seems wrong, except in respect to the scarcity of lime, to which cause we may probably attribute the fact that the more minute forms are in large majority.

It gives me pleasure to acknowledge my indebtedness and tender my thanks to Messrs. Thomas Bland and W. G. Binney, Dr. James Lewis and Prof. Edward S. Morse, for much kind help and good counsel, both before and after the completion of this manuscript.

MOLLUSCA.

Class GASTEROPODA.

Order PECTINIBRANCHIATA.

Family VALVATIDÆ.

Valvata sincera, SAY.

Lakes; San Luis Valley .... 1 specimen.

Reported also from Salt Lake (*Hemphill*); inhabits the northwest territory (*Binney*).

REMARKS.—My single shell was found dead upon the beach. It is typical, except in size, which exceeds that of any other specimens I have seen. I agree with Mr. W. G. Binney that I have never seen "specimens referred to this species that can easily be distinguished from ecarinate forms of *V. tricarinata*."

Valvata virens, Tryon.—Cœur d'Alêne Lake, Montana (*Hemphill*).

RISSOIDÆ.

AMNICOLINÆ.

Tryonia clatharata, Stm.—Colorado Desert, Cal. (*Blake*).
Tryonia protea, Gld.—Colorado Desert, Cal. (*Blake*).

Somatogyrus isogonus VAR. **subglobosus**, SAY.

Lakes; San Luis Valley .... 5 specimens.
Northwestern part of the Union (*Say*).

REMARKS.—All my specimens were dead. My time was so limited at this interesting point that I could not search the deep water for living mollusks.

Amnicola turbiniformis, Tryon.—Crane Lake Valley and Surprise Valley, Northeast California (*Gabb*); near Fort Hall, Idaho (*Reid*); Truckee, Nevada (*Carlton*).
Amnicola longinqua, Gld.—Colorado Desert (*Blake*).
Fluminicola Nuttalliana, Stm.—Warm Springs, near Salt Lake, Utah (*Reid*); Upper Des Chutes River, and Klamath River, Oregon (*Newberry*); Oregon and California (*Stimpson*).

Fluminicola seminalis, Stm.—Salt Lake, Utah (*Reid*); Oregon and Washington Territory (*Newberry*).

Fluminicola Hindsii, Stm.—Salt Lake, Utah (*Reid*); River Kootanie and stream at foot of Rocky Mountains, 4,626 feet, British Columbia (*Lord*).

REMARKS.—The last two of these three species are considered identical with the first by Mr. Binney and some others; their range seems to be co-extensive.

Fluminicola fusca, Hald.—Shores of Lake Utah (*Burton*); Sacramento River, California, to Green River, Utah (*Cooper*).

POMATIOPSINÆ.

Pomatiopsis intermedia, Tryon.—Owyhee River, Southeast Oregon (*Gabb*); White Pine district, Nevada (*Hemphill*).

MELANIIDÆ.

Goniabasis plicifera, Lea.—Rivers of Washington Territory (*Cooper*).

Goniabasis silicula, Gld.—Usually regarded as a variety of the above. Quoted from Washington Territory; Oregon; Hell-Gate River, Montana; and the Missouri above the Falls (*Cooper*).

Goniabasis Newberryi, Lea.—Upper Des Chutes River, Oregon (*Newcomb*).

Goniabasis nigrina, Lea.—Clear Creek, Shasta County, California.

Goniabasis Draytoni, Lea.—Walla Walla, Oregon; Clear Creek, Shasta County, California.

Leptoxis fusca, Hald.—Shores of Lake Utah (*Burton*).

Order PULMONATA.

PUPIDÆ.

PUPINÆ.

Cionella subcylindrica, LINNÆUS.

Camp 24: White-earth River; Northeast Antelope Park, 3 specimens.

REMARKS.—These three were found in wet grass and bushes, some 8,300 feet above the sea. Though I searched particularly for them afterward, no more were obtained.

Pupilla muscorum, LINNÆUS.

Camp 11: Blue River Valley	1 specimen.
Camp 21: Los Pinos Agency	5 specimens.

Pupilla Blandi, MORSE.

Camp 24: White-earth River	2 specimens.
Camp 26: Cunningham Gulch	40 specimens.
Camp D: Animas Valley	1 specimen.
Camp F: Rio La Plata	1 specimen.

Pupilla alticola, SP. NOV.

Animal not observed.

Shell perforate, straight, two and one-half times as long as broad, densely striate, subtranslucent, chestnut-brown, apex obtuse; whorls 6 or 7, convex, the middle three of the spire equal, causing a parallelism in the sides of the shell, the last noticeably greater, expanding toward the aperture, not closely appressed to the body-whorl; suture deeply impressed; aperture small, oblique, subtriangular, margins connected by a thin deposit, without internal processes; peristome simple, somewhat reflected over the umbilicus.

Camp 26: Cunningham Gulch .... 25 specimens.
Camp F: Rio La Plata.............................. 5 specimens.

REMARKS.—It will not be difficult to recognize this species by its parallel sides, base-like expansion of the last whorl, coarse incremental lines, and edentate aperture. It seems to be an essentially alpine species, none having been found at an elevation less than 8,000 to 9,000 feet. It was plenty in the localities mentioned above.

Leucochila arizonensis, Gabb.—Fort Grant, Arizona (*Horn*); Pike's Peak, Col. (*Tryon*); White Pine, Nevada (*Hemphill*).

Leucochila hordeacea, Gabb.—Fort Grant, Arizona (*Horn*).

VERTIGININÆ.

Vertigo californica, ROWELL.

Camp 11: Blue River Valley.......................... 15 specimens.
Camp 21: Los Pinos Agency........................... 3 specimens.
Camp 23: Divide southwest of Los Pinos............ 3 specimens.
Camp 26: Howardsville .... 50 specimens.
Camp D: Animas Valley............................... 2 specimens.
Camp F: Rio La Plata................................ 4 specimens.

Vertigo corpulenta, MORSE.

Camp 21: Los Pinos Agency........................... 2 specimens.
Camp 23: Divide, southwest of Los Pinos .... 1 specimen.

Eastern slope Sierra Nevada (*Hemphill*).

HELICIDÆ.

VITRINÆ.

Macrocyclis vancouverensis, Lea.—Idaho; west side of Cœur d'Alêne Mountains, in forests of coniferæ (*Cooper*); Sumass Prairie, Fraser River (*Lord*).

Zonites arboreus, SAY.

Camp 9: Hot Sulphur Springs......................... 3 specimens.
Camp 11: Blue River Valley .... 13 specimens.
Camp 26: Howardsville, Baker's Park................. 22 specimens.
Camp F: Rio la Plata................................ 3 specimens.

"Damp bottom-lands along the lower valley of Hell-Gate River, Montana" (*Cooper*); Washoe County, Nevada; Montana; Rio Chama, New Mexico (*Binney* and *Bland*).

Zonites viridulus, MENKE.

Camp 11:	Blue River Valley	2 specimens.
Camp 19:	Saguache Creek	12 specimens.
Camp 20:	Twenty miles west of Saguache	1 specimen.
Camp D:	Cascade Creek, Animas Valley	3 specimens.
Camp F:	Rio la Plata	4 specimens.

I find no other localities for this mollusk recorded in the inter-montanic region, except that Mr. Lord mentions finding a "*Zonites* like *electrina*, Fort Colville, Columbia River;" and Mr. Binney accredits it to the Central Province.

REMARKS.—All of these localities were at the foot of mountains, and in each case the animals were found in the wet shaded ground beside running water. In the valleys of the Animas and La Plata, they were very abundant under logs.

Zonites indentatus, Say.—Accredited by Mr. Binney (Bull. Mus. Comp. Zoöl., III, ix, 202) to the Central Province, as having been derived from the north.

Zonites nitidus, Müll.—Colorado (*Carpenter*).

Zonites Whitneyi, Newc.—Lake Tahoe, Sierra Nevada, 6,100 feet (*Cooper*); Truckee, Nevada (*Carlton*).

Zonites Breweri, Newc.—Truckee, Nevada (*Carlton*); Lake Tahoe (*Newcomb*).

Zonites minusculus, Binney.—Accredited in Binney's catalogue to the Central Province; Fort Grant, Arizona (*Horn*).

Zonites conspectus, BLAND.

Camp 26: Cunningham Gulch, altitude 11,000 feet...... 1 specimen.

REMARKS.—No mention has been made of this species that I am aware of since its description by Mr. Thomas Bland (Ann. N. Y. Lyc. N. H., VIII, 163), who quotes San Francisco, California, as its habitat.

Zonites fulvus, DRAPERNAUD.

Camp 9:	Hot Sulphur Springs	5 specimens.
Camp 10:	Mouth of Blue River	5 specimens.
Camp 20:	Twenty miles west of Saguache	2 specimens.
Camp 24:	White Earth River	35 specimens.
Camp 26:	Howardsville, Baker's Park	25 specimens.
Camp D:	Animas Valley	10 specimens.
Camp F:	Rio la Plata	6 specimens.
Camp P:	Head of Mineral Creek	25 specimens.

Found heretofore in the White Pine district (*Hemphill*) and Truckee Valley (*Carlton*) of Nevada; and at Lake Tahoe (*Cooper*).

REMARKS.—My specimens vary in size and proportion, many being young. The highest localities, it will be noticed, yielded the greatest number of specimens, as Camp 24 (8,300 feet), Camp 26, and Camp P (9,300 feet).

Vitrina limpida, Gould.

Camp 24: White-earth River, Northeast Antelope Park . 25 specimens.
Camp 26: Howardsville, Baker's Park . . . . 3 specimens.
Camp D: Animas Valley . . . . 12 specimens.

Remarks.—I do not find this species anywhere recorded from the central basin. It was, therefore, after long hesitation that I separated these specimens from the following species, which includes the majority of the *Vitrinæ* collected, and has a co-extensive distribution.

Vitrina Pfeifferi, Newcomb.

Camp 21: Los Pinos Agency . . . . 25 specimens.
Camp 23: Timber Line, Northeast Antelope Park . . . . . 15 specimens.
Camp 26: Howardsville, Baker's Park . . . . 40 specimens.
Camp F: Rio La Plata . . . . 4 specimens.
Camp P: Head of Mineral Creek . . . . 6 specimens.

Carson Valley, Nevada (*Newcomb*); Lake Tahoe (*Cooper*); head of Gunnison River, Colorado (*Carpenter*).

Remarks.—It will be noticed that all my localities are southern, but at a great elevation, those from Mineral Creek having been collected in a snow-storm. It is well known that "the animal is very hardy; for, according to Nilson, it is found crawling about among leaves in the southern part of Sweden, in the depth of winter, and it is also found in the most northern part of that country." The gentlemen of the United States Exploring Expedition found their specimens almost universally on the tops of mountains.

Limax montanus, sp. nov.

Color bluish-gray. Form stout, with blunt posterior extremity. Length exceeding one inch.

Jaw as usual in the genus. Lingual membrane long and narrow. Teeth 50–1–50, with 16 perfect laterals. Centrals with base of attachment slightly longer than wide; inferior lateral angles not much produced, lower margin incurved; reflection slightly shorter than one-half the base of attachment; tricuspid, the outer cusps short, stout, bearing short, stout cutting-points; the median cusp stout, reaching almost to the lower edge of the base of attachment, beyond which projects the cutting-point; laterals like the centrals, but unsymmetrical, as usual, by the suppression of the inner cusp with its cutting-point and inner lower lateral expansion of the base of attachment. There are 16 perfect lateral, beyond which are several teeth forming the usual gradual transition to the marginals. These latter are aculeate, the cutting-points bearing at about the center of their lower edge a blunt spur, which is a modified form of the bifurcation of the marginal teeth often found in *Limax*. The marginal teeth have the usual characteristic arrangement in oblique rows, and the separate teeth, as they pass outward, have at first the usual rapid increase for a short distance, and thence gradual decrease in size.

A reference to the exhaustive article on the lingual dentition of American *Pulmonata*, about being published in the Proceedings of the Philadelphia Academy of Natural Sciences, 1875, by W. G. Binney, shows that this species differs in its dentition from all the *Limaces* now known to inhabit North America. *L. flavus* and *maximus* have no cutting-points to the side-cusps of centrals and laterals. *L. Hewstoni* has well-developed inner cutting-points to its inner lateral teeth, which, in-

deed, are scarcely distinguishable from the centrals. *L. agrestis* has also a peculiar inner cutting-point to its laterals. *L. campestris* has the same type of central and lateral teeth as the species under consideration, but its inner marginals are simple, not bifid. *L. Weinlandi*, known only by its dentition, no description of its external characters or genitalia having been published (see Hynemann, Malak. Blätt., X, 212, pl. ii, fig. 1), differs from this species by having all its marginals simple.

The above comparison of the dentition is given in detail, because it is on its lingual membrane that I am forced to rely for decided specific characters; the external characters of the animal being of little value in alcoholic specimens.

In the genital system, there are no accessory organs. The penis-sac is as long as the vagina, with a constriction near its commencement, and tapers above to a point, below which it receives the vas deferens. The genital bladder is oval, with a very short duct entering the vagina above the penis-sac.

Camp 9: Hot Sulphur Springs .... 1 specimen.

REMARKS.—My notes taken on the spot were lost. The externa characters of the animal in alcohol are unreliable, hence the brief de scription.

Limax castaneus, SP. NOV.

Small and slender; length less than one inch; color, a lively brown, with a darker spot over the shield; head, tentacles, and eyestalks black. Bottom of foot white.

Jaw as usual; lingual dentition as in the other form, but differing in having only 34–1–34 teeth, with 12 perfect laterals. This important difference is such as to warrant the belief that the form may prove a distinct species. Genitalia not examined.

Camp 10–11: Blue River Valley .... 5 specimens.

REMARKS.—The above *Limaces* were submitted to Mr. W. G. Binney for anatomical examination. The drawings and descriptions of the jaw, lingual apparatus, and genitalia of both reproduced in the plate were furnished by him, to whom really belongs the credit of discriminating their specific distinction.

Limax campestris, Binney.—Truckee, Nevada, 5,866 feet (*Cooper*), is the only other mention I can find of the occurrence of this family in the central basin.

HELICINÆ.

Patula Cooperi, W. G. BINNEY.

Camp 9: Hot Sulphur Springs, Middle Park .... 7 specimens.
Camp 11: Blue River Valley .... 30 specimens.
Lakes, San Luis Valley .... 2 specimens.

California to Nebraska, Montana to Arizona. Most of the many recorded localities are in the mountains; the highest being 5,500 feet.

REMARKS.—This well-known Helix, the largest of any collected, was not uncommon in Middle Park and North Park (*Barber*), where great numbers of dead shells would be found in isolated spots; only a few live ones being found in wet places in the vicinity. In the Blue River Valley, we crossed a belt a hundred yards or so wide, and apparently miles in length, where the surface was thickly strewn with bleached shells, as though an army of these mollusks had been overtaken on the march by universal destruction.

Patula solitaria, Say.—Cœur d'Alêne Mountains, 2,500 feet (*Cooper*, *Hemphill*).

Patula strigosa, Gould.—Western New Mexico to the Big Horn Mountains of Nebraska (*Binney* and *Bland*); Montana to Arizona (*Cooper*).

Patula Hemphilli, Newc.—White Pine, Nevada, 8,000 feet (*Hemphill*).

Patula idahoensis, Newc.—Between Idaho City and Cœur d'Alêne Mountains (*Hemphill*).

Patula Haydeni, Gabb.—Weber Cañon, Utah (*F. V. Hayden*). Subfossil only.

REMARKS.—"In the foregoing paper, the following species of *Patula* are enumerated, viz: *Cooperi*, *solitaria*, *strigosa*, *Hemphilli*, *idahoensis*, and *Haydeni*. In form, these species are remarkably connected.

"*Patula Haydeni*, which may be considered as extinct, is distinguished by its carina and equally 'prominent, elevated, revolving ribs.' It is allied to *P. strigosa*, and more especially to the carinated form described as *P. Hemphilli*. The non-carinated *P. strigosa* is variable, sometimes difficult to be distinguished from depressed varieties of *P. Cooperi*. The rather strongly-ribbed variety of the latter, from Bear River, Utah, connects *P. idahoensis* with this group. In some specimens of that species, the obsolete carina may be observed on the periphery between the strongly-elevated oblique (not revolving) ribs. The more globose forms of *P. Cooperi* may be compared with *P. solitaria*. In the group of species of *Patula* referred to, the alliances, indicated however by the shells alone, are associated with well-marked specific differences in the genitalia; in other groups, *Mesodon*, for instance, in the dentition. Mr. W. G. Binney has lately directed attention to this interesting point."—THOS. BLAND. *Letter of March* 16, 1875.

Patula Hornii, Gabb.—Fort Grant, Arizona (*Horn*).

Patula Cronkhitei, NEWCOMB.

Camp 9: Hot Springs	14 specimens.
Camp 11: Blue River Valley	20 specimens.
Camp F: Rio La Plata	15 specimens.

Recorded from Klamath Valley, Oregon (*Gabb*); White Pine Mountains, Nevada, and Northern Utah (*Hemphill*).

Patula striatella, ANTHONY.

Camp 9: Hot Springs	20 specimens.
Camp 19: Saguache	5 specimens.
Camp 24: White-earth River	20 specimens.

Montana? (*Cooper*); Hell-Gate River, Montana (*Binney* and *Bland*); Estes Park, Colorado (*Carpenter*).

Helix (Microphysa) Ingersollii, BLAND, *in* MSS.

Camp 26: Baker's Park	25 specimens.
Camp 26: Cunningham Gulch, 11,000 feet	6 specimens.
Camp D: Animas Valley	25 specimens.

REMARKS.—This beautiful little shell was not found north of the crests of the Sierras about Baker's Park, but was not uncommon on their southern slopes, where I first found it clinging to vertical and all but inaccessible cliffs in Cunningham Gulch, at an altitude of over 11,000 feet, exposed to daily snow-storms; yet these specimens were, if anything, finer than those subsequently found along the Rio Las Animas.

Helix lineatus, Say.

Camp D: Animas Valley .... 1 specimen.

Rio Chama, N. Mex. (*Binney* and *Bland*); Salmon River, Idaho (*Hemphill*).

Helix Polygyrella, Bld. and J. G. Cp.—Common on Cœur d'Alêne Mountains (*Cooper*).
Helix Columbiana, Lea.—Hell-Gate Valley, Montana (*Hemphill*); Fraser River (*Lord*).
Helix devia, Gld.—Intruding into Idaho (*Binney*); Deer Lodge Valley, Montana (*Hemphill*).
Helix loricata, Gld.—Sierra Nevada (*Cooper*).
Helix Mullani, Bld. and J. G. Cp.—Cœur d'Alêne mission, Bitter Root Mountains and River, Idaho (*Cooper*); Idaho (*Binney*).
Helix fidelis, Gray.—Large but very pale variety, Sumass Prairie, Fraser River (*Lord*).
Helix Townsendiana, Lea.—"Both slopes of the Bitter Root Mountains, from 2,200 to 5,000 feet high. Large variety at the base of the range to 4,800 feet; small variety in dry prairie at junction of Hell-Gate and Bitter Root Rivers" (*Cooper*). Sumass Prairie, Fraser River; small variety Fort Colville, summit of Rocky Mountains (*Lord*); east of Fort Colville Washington Territory (*N. W. Bound. Surv.*).

Remarks.—The small variety from Northwest Idaho has been described as a new species by Mr. A. D. Brown under the name of *Helix ptychophora* (Journal de Conchologie, 1870), giving as its habitat Bitter Root Mountains and Nebraska. Mr. Bland considers it as a variety only.

Helix pulchella, Say.

Camp 11: Blue River Valley .... 16 specimens.
Camp 20: West of Saguache........................ 4 specimens.
Camp 21: Los Pinos Indian Agency .... 65 specimens.
Camp 26: Howardsville, Baker's Park .... 50 specimens.
Camp F: Rio La Plata............................ 10 specimens.

"This American form [*minuta*] of the Old-World *pulchella*, Müll., has only lately been found west of the Rocky Mountains. I obtained an immature specimen near Truckee, in May. * * * Mr. Harford afterward found it common near Donner Lake, a few miles above Truckee; and Mr. Hemphill has also found them common near White-Pine Mountains. Not having been found north of Canada, its circumpolar distribution, though asserted by Middendorf, is doubtful; he, like most authors, considering it identical with *pulchella*."—Dr. J. G. Cooper.
Helix Dupetit-Thouarsi, Desh.—Klamath Lake, Oregon (*Newberry*); Sumass Prairie (*Lord*).

Helix tudiculata, Binn.—Truckee, Nevada (*Carlton*).

SUCININÆ.

Succinea Nuttalliana, Lea.

Camp 9: Hot Sulphur Springs .... 30 specimens.
Camp D: Animas Valley .... 1 specimen.

"Warm Springs, near Salt Lake, Utah (*Reid*); Snake River (*Nuttall*); Wright's Lake and Rhett's Lake, Northeast California (*Newberry*).

Succinea ovalis, GOULD.

Camp 10: Mouth of Blue River .... 1 specimen.

Succinea rusticana, GOULD.

Camp 9: Hot Sulphur Springs........................ 12 specimens.

Sumass Prairie, Fraser River (*Lord*); Rocky Mountains of Bitter Root Valley, 2,500 to 4,500 feet (*Cooper*); White Pine region, Nevada (*Hemphill*).

REMARKS.—These three species are hardly to be distinguished. I separated them as above after examination of shells in the Museum of Comparative Zoölogy, but they merge into one another indeterminately.

Succinea Hawkinsii, Baird.—East of Fort Colville, Washington Territory (*N. W. Bound. Survey*); Lake Osoyoos (*Lord*).
Succinea Sillimani, Bland.—Humboldt Lake, Nevada (*Silliman*).

Succinea lineata, W. G. BINNEY.

Camp 20: 20 miles west of Saguache.................. 8 specimens.
Camp D: Animas Valley.............................. 50 specimens.
Lakes San Luis Valley .... 10 specimens.

Northeast California to Nebraska and British Columbia (*Cooper*); Utah, Yellowstone River (*Smithsonian Catalogue*); Little Colorado, Arizona (*Palmer*); Estes Park, Colorado (*Carpenter*).

REMARKS.—I should not quarrel with any one who should pronounce some of the smaller of my specimens to be *S. Stretchiana*, Bld. Yet upon comparison with shells in the Museum of Comparative Zoölogy, I prefer to call them all by the above name. They include but four living snails among the whole number, the rest being dead shells.

Succinea Stretchiana, Bland.—Little Valley, Washoe County, Nevada (*Stretch*).

REMARKS.—If, as is indicated by the map appended to Mr. Binney's catalogue (Bull. M. C. Z., III, IX), the Central Province includes the valley of the Yellowstone as far east as its mouth, *Succinea Haydeni*, W. G. Binn., and *S. retusa*, Lea, must be considered to belong to our list, and several localities on the Yellowstone River can be added to the distribution of *S. lineata*, as well as to that of quite a number of shells in other families.

PHYSIDÆ.

Physa heterostropha, SAY.

Camp 9: Hot Sulphur Springs........................ 100 specimens.
Camp 18: Springs east of Saguache.................. 40 specimens.
Between the Animas and La Plata.................... 5 specimens.

Its range from the Atlantic to the Pacific is well assured, it having been collected in nearly every State and Territory.

REMARKS.—My specimens show the greatest variation in point of size, shape, and color; yet, in the absence of other types, all seem referable to this species. The Grand River, which flows through Middle Park, contains no *Physæ* (or other mollusks) that I could discover; but at the

Hot Springs, in a little lagoon filled at high water, large, clear, *ampullacea*-like shells were common. In the few yards of exposed outlet of the springs of hot sulphur-water from which the locality derives its name and celebrity, there occurred in the greatest profusion a blackish globose variety about one-fifth of an inch long. The temperature of this water was at some points as high as 100° F. In the basin of a still hotter spring close by, whose waters were saturated with chlorides of sodium and magnesium, hundreds of still smaller *Physæ* (see below) were floating about in mats, glued together by a tangle of confervoid vegetation and the depositions of the water. All of these seemed to have lost the apex of the spire by erosion, "which is extremely liable to happen to shells living in water charged with alkaline salts other than lime." Yet quite as small and black were the examples from the cold, clear, abundant springs near Saguache, where there was seemingly nothing whatever to stunt their growth.

Physa Wolfiana, Lea.

In the Proceedings of the Philadelphia Academy for 1869, Mr. Isaac Lea described a species of *Physa* from "the Hot Sulphur Springs, Colorado," collected by Prof. J. W. Powell, which he named *Physa Wolfiana*. Inasmuch as my shells came from the exact and very limited station and locality (*vide* Observations, XIII, 67; Pl. XXI, fig. 20) as his types, I suppose I must have it; but as I cannot separate to my satisfaction those which resemble that shell as described and figured from those which do not resemble it, I have remanded all to the foregoing species.

Physa Lordi, Baird.—British Columbia (*Lord*), replacing *P. heterostropha* on the higher ground toward the Rocky Mountains; east of Fort Colville, Washington Territory (*Northwestern Boundary Survey*).

Remarks.—It is not unlikely that *P. Clarkei* and the two following species will prove identical with this, differing only in size and color. Here, as in *Limnea*, the shell is subject to such variation that it is precarious to predicate specific rank upon the shell alone, particularly if the specimens be few and localities isolated.

Physa ampullacea, Gould.—Oregon and Washington Territory (*Cooper*); Rhett's Lake, California, and Upper Klamath Lake, Oregon (*Newberry*).

Physa ancillaria, Say.—Ruby Valley, Utah (*Simpson*).

Physa gyrina, Say.—Carson, Nevada (*Wheatley*); Utah (*Simpson*).

Physa humerosa, Gould.—Colorado Desert, Pecos River (*Blake*).

Physa Grosvenorii, Lea.—Dayton, Nevada (*Wheatley*).

Physa parva, Lea.—Little Valley, Nevada (*Wheatley*).

Physa Hawnii, Lea.—White Pine, Nevada (*Hemphill*).

Physa Saffordii, Lea.—Fort Hall, Idaho, and Snake River Valley, Utah (*Reid*); Nevada and Eastern Idaho (*Hemphill*).

Physa virgata.—Gila River (*Gould*).

Physa propinqua, Tryon.—White Pine, Nevada (*Hemphill*); Jordan Creek, Southwest Idaho (*Gabb*).

Physa occidentalis, Tryon.—Fort Colville, Washington Territory (*Horn*); Warner's Valley, Oregon (*Gabb*); Truckee, Nevada (*Carlton*).

Physa Blandii, Tryon.—Truckee, Nevada (*Carlton*).

Physa malleata, Tryon.—Hell-Gate River, Montana, and Fandango Valley, a part of Goose Lake Valley, Oregon (*Gabb*).

Physa Nuttallii, Lea.—Lewis River, Idaho (*Nuttall*).

Physa Cooperi, TRYON.

Between the Animas and La Plata.................. 5 specimens.

Also recorded from a spring in Crane Lake Valley, Northeast California (*Gabb*).

REMARKS.—I do not feel quite sure of this determination, because of the immaturity of the specimens, and the fact that I do not have access to types; nor do I altogether trust in the validity of the species.

Bulinus hypnorum, LINN.

Camp 9–10: Grand River Valley...................... 50 specimens.

Recorded also from Hell-Gate River, Montana (*Cooper*); Utah; Malade River, Idaho (*Hemphill*); Washington Territory; Yellowstone River (*Smithsonian Catalogue*); British possessions (*Lord*) northward.

PLANORBINÆ.

Helisoma plexata, SP. NOV.

Shell a little larger than P. TRIVOLVIS, Say, *of irregular proportions, fragile; whorls 4–5, the inner 3–4 of the spire angulated and coiled in a plane, which is considerably inclined to the plane of the outer revolution in such a way that the carina of the third whorl rises into a sharp shoulder on the right side*, and on the left side sinks underneath the overflowing last whorl, which takes on a sudden increase in old age. A similar, but less, change in the plane often occurs again in the fourth whorl, giving a very twisted appearance to the shell. Surface marked by irregularly-crowded, wavy, raised lines of growth. Umbilicus broad, exhibiting the well-rounded whorls to the apex. Aperture somewhat oblique, pretty regularly pyriform in outline, the vertical slightly exceeding the horizontal diameter, and embracing a considerable portion of the body whorl, well to one side of the median line. Peristome gently reflected, slightly thickened within, and fully lined with an opaque white deposit, which also forms a thick and well-defined callus connecting the ends. Color yellowish horn to reddish-brown (becoming almost black behind the aperture), most specimens abundantly banded and streaked with revolving lines of ochraceous red, and fine black threads.*

Saint Mary's Lake, Antelope Park.................. 25 specimens.

REMARKS.—This species existed in countless numbers in the above-mentioned lake, which is a small sheet of water held among precipitous cliffs, which afford it no visible outlet. It seems to be merely a "sink" for the melted snow of the surrounding heights. All of the hundreds of individuals seen, possessed, in a more or less marked degree, the twisted appearance, resulting from the change of plane in the old age of the shell, which is their most striking character. How the species came, almost entirely alone, to inhabit this secluded lake is a problem, complicated by the fact that there is not probably another large *Planorbis* within fifty miles. That the wild fowl, abundant on the lake, brought the eggs clinging to their feet, may be a plausible explanation; but where did they bring them from, and when? The bottom of the lake is, for the most part, rough, conglomerate rock, and it is in many places filled with heavy water-plants, which may account for the peculiarities of the shell.

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* As you hold the shell-spire upward, and look into the aperture.

Helisoma trivolvis, SAY.

Pond between the Animas and La Plata .... 10 specimens.

There is a long list of recorded localities from all the Territories, as well as British America and the Pacific coast, so that it seems universally distributed over this continent.

REMARKS.—This pond was entirely isolated, and of several acres in extent, resorted to by vast flocks of wild fowl, and inhabited by all sorts of fresh-water and amphibious life. The bottom was muddy, and nearly the whole expanse choked with luxurious vegetation.

All of the shells, which were quite abundant, seem to belong to this species, although there are scarcely two alike. One resembles closely *P. macrostomus*, Whiteaves; another is near *P. tumens*, Cpr.; a third variety might be identified as *P. glabratus*, Say, if that shell were dextral; yet, while all differ in development and in color, all agree in being very fragile, which may be owing partly to scarcity of lime in the water, and partly to the soft bottom; and in having a short vertical diameter, which peculiarity may have been acquired by them from the necessities of their habitat, since snails having shells with small breadth of beam could most advantageously pass between the stalks of standing water-plants which everywhere crowd the pond.

Helisoma ammon, Gld.—Colorado Desert (*Blake*); Klamath Lake, Oregon, and Rhett Lake, California (*Newberry*); east of Fort Colville, Washington Territory (*Northwestern Boundary Survey*).

Helisoma Traskei, Lea, is probably a synonym of the above.

Helisoma corpulentus, Say.—Oregon and Washington Territory (*United States Exploring Expedition*); Lake Osoyoos, Washington Territory (*Marsh*); British Columbia (*Lord*); Okanigan River, Washington Territory (*Cooper*). It seems doubtful whether this is not a synonym of *H. trivolvis*.

Planorbis oregonensis, Tryon.—Pueblo Valley, on the boundary between Oregon and Nevada (*sic*), "from a thermal spring, water above blood-heat" (*Gabb*).

Planorbis subcrenatus, Cpr.—Oregon (*Nuttall*); Washoe, Nevada (*Newcomb*); Sumass Prairie, British Columbia (*Lord*).

Planorbis Hornii, Tryon, Utah (*Sur. W. of 100th M.*); Truckee River, Nevada (*Carlton*).

Planorbis gracilentus, Gld.—Colorado Desert (*Webb*). Seems to be a northern form of *P. Liebmanni*, Dunker.

Gyraulus parvis, Say.

Camp 9: Hot Sulphur Springs .... 1 specimen.
Arkansas River, ten miles below Granite .... 5 specimens.
Between Rio Animas and Rio La Plata .... 2 specimens.
Saint Mary's Lake, Antelope Park .... 50 specimens.

It occurs also in Hell-Gate River, Montana (*Cooper*); Cœur d'Alêne Lake, Montana (*Hemphill*); Ruby Valley, Utah (*Simpson*); and along the Yellowstone (*Smiths. Catal.*).

Gyraulus vermicularis, Gld.—Truckee, Nevada, altitude 5,866 feet, rare; Dalles, Oregon (*Cooper*).

POMPHOLIGINÆ.

Pompholx effusa, Lea.—Near White Pine, Nevada (*Hemphill*); Northeastern California (*Newberry*).

Carinifex Newberryi, Lea.—Klamath Lake, Oregon (*Newberry*).

ANCYLINÆ.

Vorticifex Tryoni, Meek.—Fossil in Tertiaries of Nevada (*King*).
Ancylus Newberryi, Lea.—Klamath Lake, Oregon (*Newberry*).
Ancylus kootaniensis, Baird.—Rivers Kootanie and Spokane (*Lord*).
Ancylus patelloides, Lea.—Spokane River, Washington Territory [approaching *A. kootaniensis*] (*Hemphill*).
Acroloxus Nuttallii, Hald.—Oregon (*Nuttall*); lower part of Snake River, Washington Territory (*Hemphill*).

LIMNÆIDÆ.

LIMNÆINÆ.

Limnea stagnalis, LINNÆUS.

Between the Animas and La Plata .... 2 specimens.

Fraser River, typical, fine, and abundant (*Lord*); east of Fort Colville (*Northwest Boundary Survey*); Rhett's Lake, California (*Newberry*); Ruby Valley, and Southern Utah (*Simpson*). Circumpolar.

Limnea sumassi, BAIRD.

Between the Animas and La Plata .... 1 specimen.

East of Fort Colville, Washington Territory (*Northwest Boundary Survey*); Sumass Prairie (*Lord*).

Limnea Haydeni, W. G. B.—Yellowstone and Big Sioux Rivers (*Hayden*); Ruby Valley, Utah (*Simpson*).

Limnea ——?

Camp 30: Rio Grande, above Del Norte .... 50 specimens.

REMARKS.—"Near *L. Rowellii*, Tryon."—Dr. JAS. LEWIS, *in letter*.

Limnea palustris, MÜLLER.

Between the Animas and La Plata .... 2 specimens.

Columbia River (*Nuttall*); Klamath Lake and Sumner Lake, Oregon; Rhett's Lake and Wright's Lake, California (*Newberry*); Hell-Gate River and Missouri River above Falls (*Cooper*).

Limnea Nuttalliana, LEA.

Between Animas and La Plata Rivers .... 75 specimens.

REMARKS.—Often considered a synomym of *L. palustris*, with which, in the West, it seems to be co-extensive.

Limnea ——?

Colorado .... 5 specimens.

REMARKS.—"An umbilicate species, for which I find no name."—Dr. JAS. LEWIS, *in letter*.

Limnea desidiosa, SAY.

Camp 9: Hot Sulphur Springs .... 10 specimens.
Camp 11: Blue River Valley .... 10 specimens.

Lake Osoyoos, Washington Territory (*Lord*); Missouri River above the Falls (*Cooper*); Yellowstone River (*Hayden*).

Limnea catascopium, Say.—New England to Lewis [Snake] River, and through British America (*Binney*); Lake Utah (*Burton*); Idaho (?).
Limnea Binneyi, *Tryon*.—Hell-Gate River, Montana (*Binney*).
Limnea emarginata, Say.—New England to Washington Territory (*Auct.*).

Limnea —— ?

Colorado .... 6 specimens.

REMARK.—"Comes near *L. Traskii*, but distinct."—Dr. JAS. LEWIS, *n letter.*

Limnea bulimoides, Lea.—Oregon (*Nuttall; Hayden*).

Limnea humilis, SAY.

Camp 17: San Luis Valley .... 2 specimens.
Camp 26: Howardsville, Baker's Park .... 1 specimen.

"All over the continent" (*Lewis*); Hell-Gate River, Montana (*Cooper*).

Limnea ferruginea, HALDEMAN.

Between the Animas and La Plata .... 2 specimens.

Oregon (*Nuttall*).

REMARKS.—"If not *L. ferruginea*, it may be new."—Dr. JAS. LEWIS, *in letter.*

Class CONCHIFERA.

Order DIMYARIA.

Family CORBICULADÆ.

Sphærium striatinum, Lamarck.—Hell-Gate River and Missouri River above the Falls (*Cooper*); Humboldt River, Nevada (*Hepburn*).
Sphærium occidentale, Prime.—Hell-Gate River (*Cooper*).
Sphærium dentatum, Hald.—Oregon (*Nuttall*).
Sphærium patella, Gould.—Walla-Walla, Oregon (*U. S. Expl. Exped.*).
Sphærium lenticula, Gld.—Lake Tahoe and Carson River (*Cooper*).
Sphærium tumidum, Baird.—Sumass Prairie, Fraser River (*Lord*).
Sphærium spokani, Baird.—Spokane and Kootanie Rivers (*Lord; Hemphill*).
Sphærium tenue, Prime.—I am confident that I secured this species (one specimen) at the Rio La Plata. It has been recorded, I think, from Montana and another northern locality.

Pisidium abditum, HALDEMAN.

Camp 9: Hot Springs .... 30 specimens.
Camp D: Animas Valley .... 1 specimen.
Saint Mary's Lake, Antelope Park .... 1 specimen.

Raft River, near Fort Hall, Idaho (*Reid*); Truckee River (*Carlton*).

REMARKS.—These specimens vary greatly in color, but seem to be all referable to this widely-distributed species. Many young, about half-grown.

Pisidium compressum, Prime.—White Pine, Nevada; Owen's River, California (*Hemphill*).

Pisidium occidentale, Newc.—Truckee River, Nevada (*Carlton*).

Pisidium ultramontanum, Prime.—Canoe Creek, Pitt River, California (*Cooper*).

UNIONIDÆ.

Unio luteolus, Lam.—Missouri River, above the Falls (*Cooper*).

Margaritana margaritifera, Linn.—Missouri River above the Falls; Spokane River below Cœur d'Alêne Lake (*Cooper*); Salt Lake, Utah, or Fort Hall, Idaho (*Reid*); Truckee River, Nevada (*Carlton*).

Anodonta angulata, Lea.—Idaho, Montana (*Cooper*); Columbia River (*Lord*).

Anodonta oregonensis, Lea.—Abundant east and west of the Cascades (*Lord*); Montana (*Cooper*).

Anodonta Nuttalliana, Lea.—Idaho (*Cooper*).

Anodonta whalamatensis, Lea.—Idaho, to British Columbia (*Cooper*).

Anodonta californiensis.—Colorado River (*Cooper*).

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DEPARTMENT OF THE INTERIOR.

BULLETIN

OF

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GEOLOGICAL AND GEOGRAPHICAL SURVEY

OF

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BULLETIN, NO. 3—SECOND SERIES.

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SAGUACHE
Department of the Interior
U S Geological and Geographical Survey of the Territories
F V Hayden U.S. Geologist in Charge
Preliminary Map
of
SAN JUAN COUNTRY
A D Wilson

DEPARTMENT OF THE INTERIOR.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

TOPOGRAPHICAL AND GEOLOGICAL REPORT

ON

THE SAN JUAN COUNTRY.

BULLETIN, NO. 3.—SECOND SERIES.

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MEANS OF COMMUNICATION BETWEEN DENVER AND THE SAN JUAN MINES.

By A. D. Wilson, *Topographer directing.*

The Denver and Rio Grande Railroad is now running daily trains to Colorado Springs, Pueblo, and Cañon City. Persons wishing to reach the new mining district may take the train to either of the three previously mentioned places, and at these points they will have to provide themselves with animals, except by way of Cañon City. From this place there was during last summer a regular line of stages running to Saguache and Del Norte, but from these latter places there is not at present any public conveyance. I mention the three points of starting, as they are all more or less traveled.

Colorado Springs is situated some seventy-six miles south of Denver on the Denver and Rio Grande Railroad. Leaving the railroad at this point, the traveler is obliged to procure his own conveyance, as there is not at present any public conveyance from there to Saguache or Del Norte. The road from here leads by way of Manitou up the Fontaine qui Bouille, crossing South Park at its southern end, passing by the Salt-Works; thence down Trout Creek to the Arkansas River, which it follows down some miles to the South Arkansas. At this point the road joins with the one from Cañon City, and then, following up Puncho Creek, leads through a pass of the same name to San Luis Valley, thence skirting this valley along its western border to Saguache. This road is somewhat longer than the others, but a very good and pleasant one to travel, especially during the warmer portions of summer. The distance by this route from Colorado Springs to Saguache I estimated at one hundred and seventy miles.

The next route south is by way of Cañon City. This place is situated on the north bank of the Arkansas River, near where it emerges from the mountains, about one hundred and sixty miles from Denver by rail.

The road from Cañon City passes around the first cañon by keeping some distance to the north of the river, then, swinging south, crosses the river and again leaves it, passing through the north end of Wet Mountain Valley, where it again turns to the north and strikes the river in Pleasant Valley; thence following up the river until it joins the Colorado Springs road, where it crosses the South Arkansas. It is about one hundred and ten miles by this road from Cañon City to Saguache. Pueblo is situated also on the Arkansas River, about thirty-five miles below Cañon City, and one hundred and eighteen miles by rail from Denver. The road leading out from this place crosses the plains toward the southwest and strikes the Huerfano River at Badito. At this point the road forks, one following up the river and crossing the Sangre de Cristo range through the Mosca Pass, thence crossing the San Luis Valley to Del Norte. The other branch of this road crosses the river, and keeps farther to the south, crossing the range through the Sangre de Cristo Pass, strikes the valley at Fort Garland, and cross-

ing from there to Del Norte. Both branches have to contend with the great sand-drifts which have accumulated on the eastern edge of the San Luis Valley; the one by way of Mosca Pass being probably the shortest by some miles, but at the same time having more sand to contend with. With the exception of the sand, this is a very good road. I estimated the distance from Pueblo to Del Norte by Mosca Pass to be one hundred and twenty miles. I merely mention briefly these different roads to Saguache and Del Norte to give the traveler some idea how to reach these points, as they are the last places of any note on the way. Saguache is located on a small stream of the same name, where it leaves the mountains and enters the San Luis Valley. The enterprising citizens of this place have already gone to considerable expense in building a wagon-road which is to connect this place with the San Juan mines. But I fear it will take more labor and money to make it a good road than they at present can afford to expend on it. This road is only approximately located on the accompanying map, owing to its unfinished condition when we passed through that portion of the country. The construction-party was, when we passed them, August 12, nearly up to the junction of Godwin Creek and Lake Fork. They had brought their supplies over the road in wagons, but there were many places where much labor would be required to make it practicable for heavily loaded wagons. From this point on they will meet their greatest obstacles. As I understood them, they intended following approximately the course of the trail, that is up Lake Fork. By this route they can get a very good grade, but only with considerable expense, until nearing the pass, where the mountains rise quite abruptly, and it will be very difficult to construct a good road over this pass, as it is quite steep on either side. This pass is 12,540 feet above sea-level.

The trail over this pass strikes Animas River near its head, where many silver-bearing lodes have already been located. From this point it follows down the river to Howardville, a distance of about nine miles, a portion of the way being over very steep and loose *débris* slopes, over which it will be difficult to construct a road. The distance by this road from Saguache to Howardville will be about one hundred and thirty miles. There is also a trail from Saguache, which is a much shorter route for pack or riding animals than the road, but a small connecting link is wanting, which any one can easily supply by taking the accompanying map on which the trail is indicated.

From Los Pinos agency the trail follows up one of the branches of Cochetopa Creek, thence crossing over to the White Earth, which it follows up until nearing the divide between it and the Rio Grande. Here it turns to the south and descends to Antelope Park. But the traveler wishing to go to San Juan must keep on in a westerly direction, and he will soon strike a trail which leads him down to San Cristoval Lake, where he will strike the Lake Fork trail, formerly described. The distance by this trail from Saguache to Howardville is about one hundred and ten miles.

Del Norte is located on the southern bank of the Rio Grande, near the foot-hills on the west side of San Luis Valley, about thirty miles south of Saguache. This being the nearest place to the mines, it is from here that the miners procure their supplies at present. The wagon-road from Del Norte follows up the river along its southern bank, meeting with no obstacles of note until reaching Wagon-Wheel Gap. At this point, owing to a loose slide, the owners of the road were compelled to change it by building a bridge over the river. This bridge was nearly completed when we passed there. The road only crosses to recross again very soon, and continue on

the southern bank until nearing Bristol Head. Here it crosses to the northern bank; then, soon leaving the river, and skirting the foot of the mountain, crosses a low spur, and descends to Antelope Park. This point is about fifty-five miles from Del Norte. So far the road is very good, having no heavy grades, and, passing as it does over the gravelly bottoms, it is naturally solid and quite smooth for a mountain road. At this point the road again leaves the river, following up Crooked Creek for about eight miles; reaches a high pleateau, which it crosses, bearing again toward the river; descends a high and quite steep bluff; crosses and recrosses the river, when it again leaves the river for a short distance, coming upon its bottoms once more at the Half-way House. So far the road is passable for lightly loaded wagons; but from here on it is of no use in its present condition, as it is about all they can do to get an empty wagon over it. From the Half-way House the road follows up the river for some distance, when it turns to the right, and ascends quite a steep slope, winding its way along to the pass. It is at this point that the greatest difficulty is met with, owing, first, to the sudden descent of the slope from the pass to Baker's Park, the whole distance being some four miles, with a descent of 2,900 feet, and in the first two miles a descent of about 2,300 feet; and, secondly, owing to the very rocky and bluffy character of the slopes, it will be very difficult to give the road swing enough to get anything like a good grade. Still this appears to be the most practicable route at present, as there is a good road for so much of the way.

The trail from Antelope Park does not follow the same course as the road; it more nearly follows the river, and crosses a pass about one mile farther south, near the head of Cunningham Creek. This pass is a few feet lower than the one through which the road goes. Height of trail pass above sea level, 12,090 feet.

The distance by the road from Del Norte to Howardville is about ninety-five miles. There is a trail leading from Howardville down the Animas; also another leading out to the northwest to the headwaters of the San Miguel and Dolores. Both of these trails have been described by Mr. Rhoda.

The accompanying map gives the drainage in detail of the country immediately surrounding the San Juan mines, with all the important mountain-peaks, roads, trails, and other features of the country that could be represented within the limited time at my disposal. The lower portion of the Rio Grande was located preliminarily in order to show the route of the wagon-road from Del Norte.

The heights of many of the important peaks and valleys are given on the map; and there will be a list giving the heights of all the higher peaks and other important points, with an explanation of the method used in their determination by Mr. Rhoda, who has worked them up with great care.

The small contour map of Baker's Park and vicinity will give an idea of the character of the country which we were engaged in working up the past season. It will also give some idea of the care with which this region has been surveyed. Owing to the want of time, I was not able to get more of the country drawn finally for this report.

Mr. Rhoda has written quite a detailed description of the country. Therefore I will refer the reader to his chapter for any information that may be sought in regard to the appearance or character of this region.

Dr. Endlich has also written a geological and mineralogical report of the region surveyed.

Fall of the Rio Grande from Cunningham Pass to Del Norte, commencing at pass.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To the mouth of Pole Creek	4½	1,300	288.9
Thence to Lost Trail Creek	8½	1,200	141.1
Thence to Antelope Park	15	600	40
Thence to Del Norte	60	1,100	18.3

Fall of the Animas from divide between it and east branch of Uncompahgre to the lower end of Animas Park.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To upper end of Baker's Park	8	2,600	325
Thence to lower end of park	8	500	62.5
Thence to mouth of Cascade Creek	17	1,700	100
Thence to head of Animas Park	10	800	80
Thence to lower end of Animas Park	14	300	21.4

Fall of Los Pinos from Weeminuche Pass, commencing at summit of pass.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To point where trail leaves stream	6	782	130.3
Thence to west branch	9	1,200	133.3
Thence to Vallecitto Creek	12	1,000	83.3
Thence to Big Bend	6	400	66.6

Fall of Vallecitto Creek from divide between it and Rio Grande, commencing at divide.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To junction of south branch	5	2,400	480
Thence to Los Pinos	21	2,800	133.3

Fall of Rio San Miguel, commencing at Bear Creek Pass.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To valley below pass	2	2,400	1,200
Thence down stream	4	600	150
....Do.......do	2	800	400
Thence to junction of east branch	6	1,100	183.3

Fall of Uncompahgre from divide between it and Mineral Creek, commencing at divide.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To small valley	4	1,400	350
To lower end	2	200	100
To lower end of cañon	4	1,500	375
To junction of west branch	14	1,000	71.4

Fall of Lake Fork, commencing at divide west of Handie's Peak.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet.*	*Feet.*
To valley	2½	2,200	880
Thence to junction of south branch	5½	1,200	218
Thence to mouth of Godwin Creek	15	1,200	80
Thence to point where road strikes creek	21	800	38.9

Fall of Godwin Creek, commencing at divide between it and Uncompahgre.

	Distance.	Fall.	Fall per mile.
	Miles.	*Feet,*	*Feet.*
To junction with north branch	7½	2,800	374
Thence to Lake Fork	10	1,000	100

REPORT ON THE MINES AND GEOLOGY OF THE SAN JUAN COUNTRY.

By F. M. Endlich, S. N. D.

Regarding the geographical location and extent of the San Juan mining region, so called, nothing further need be said, as the subject has been sufficiently treated by the topographer in other portions of this bulletin.

For more than four thousand five hundred square miles the country is covered, in one continuous area, by volcanic rocks, beginning immediately west of the San Luis Valley, and extending in that direction as far as the high masses of mountains and plateaus. Their southern boundary may be characterized as following the line where the high and rugged peaks change for the lower densely-wooded ridges. The Gunnison may be said to indicate approximately the northern limit. One exception to the southern line must be taken, however, caused by that group of mountains which we have been accustomed to designate as the Quartzites. It is a densely-packed mass of very rugged peaks, with numerous, almost inaccessible cañons cut through it, and contains the headwaters of the Rio Pinos, and a number of swift mountain-streams, that thus far have not been distinguished by special names. Advancing from the east and north toward the quartzites it will be observed that gradually the volcanic strata begin to thin out, revealing the rock they overlie. This will be spoken of in more detail at the proper place.

The character of the volcanic rocks throughout the district is one of extreme interest, demonstrating an enormous amount of activity during a probably short period of time, (geologically speaking,) which activity was nevertheless accompanied by a comparatively large number of changes in the chemical and physical qualities of the ejected material. Local phenomena, for instance—the sudden occurrence of a certain class of rocks intimately associated with others entirely different—are frequent, and their explanation not always to be rendered satisfactorily. Traveling for many miles over this continuous volcanic area, I gradually became familiar with the different appearances and physical changes in masses that, lithologically, I could not separate. Thanks to the regularity that was observed in the succession of the different flows, thanks furthermore to the barren nature of the highly-elevated portions of the country, the geologist can treat these rocks almost like well-defined sedimentary formations. Basing upon this, I prepared in the field a schedule that roughly divides the various characteristic groups or strata and found it to answer very well. Due changes were made upon future observations and corrections applied when needed, so that now it will give a good idea of the successions of strata, leaving of course a considerable amount of room for the investigating lithologist.

No. 1. Eight hundred feet of white, yellow, green, orange, red, brown, and gray trachytes, decomposing readily, frequently weathering in pic-

turesque groups. White Earth and the Rio Grande region, near Lost Trail Creek, furnish good examples for this section.

No. 2. Twelve hundred feet of red to brown stratified trachyte, not unfrequently containing interstrata of obsidian and of pitchstone resembling obsidian. Sanidite is the predominant one of the segregated minerals. Small crystals of brown to black mica occur dispersed throughout.

No. 3. Two thousand to two thousand five hundred feet of red to brown trachyte, separated readily into No. 3 lower and No. 3 upper. The former has a more or less laminated appearance, and weathers light brown to gray, while the upper is more uniform in texture.

No. 4. Three thousand to four thousand feet of trachyte, by far the most variable of all in its distinctive lithological characteristics. In color it varies from a dark purplish blue to maroon, frequently weathering brown on the surface. As a rule it is rather compact, having a microcrystalline paste, and but few segregated minerals. The lower portion of No. 4 contains what I am accustomed to call the "*Red Stratum*," which will frequently be mentioned below. It is of considerable importance in the consideration of the minerals, and presents one of the most striking features in the orographic characteristics of the country. The decomposition of pyrite produces this coloring, and every shade, from white through yellow, orange, and red, to dark brown occurs. These four groups, of an aggregate thickness of 7,000 to 8,000 feet, contain the main mass of the volcanic rocks. Above them follow, but not in such continuous masses nor regular succession, rhyolite, dolerite, and basalt.

Had not the stratigraphical conditions of these various flows or strata been a very regular one, a recognition of their relations *inter se* and their respective position could not easily have been obtained. Strange to say, even the points of elevation at which the different groups were found do not vary to any great extent.

On White Earth, for instance, No. 1 is exposed, giving through the light color of the stratum the creek its name. At that point the elevation is about 9,100 feet, and on the Rio Grande, near Lost Trail Creek, an air-line distance of twenty-four miles from White Earth, the same formation occurs at an elevation of 9,800 feet. Inasmuch as the dip, though gentle, is a north to northeasterly one, this small difference can be accounted for.

Having recognized the striking uniformity of the several strata at numerous points, the surprising regularity of the dip and the almost entire absence of later eruptive rocks in any of the lower sections of country point strongly to the common origin from one point of outflow. Taking station 10 and the region immediately north of it as a center, it can be observed that the volcanic strata dip off from it on all sides, except in the immediate vicinity, where there is some irregularity in the dip. From the neighborhood of that peak the numbers, as distinguished above, can be traced in every direction, and readily recognized. A few miles east of station 10 was the only place where basalt was found *in positu* in a cañon; the only place, furthermore, where rhyolite occurred in quantity as well as at the station itself. Having two of the youngest volcanic rocks in an apparently so abnormal position, as their dips by no means indicate that they could have flown from some high neighboring point, and taking into consideration the almost undisturbed condition of the surrounding rocks, I have come to the conclusion that the main center of eruption for that section of country was from this point.

After the eruption had taken place, it seems a subsidence occurred

near station 10, a subsidence that covered a considerable area of ground. From various sides the dip of strata can be noticed to incline toward the region a little north of the station, while outside they dip off again. In the Annual Report of the United States Geological Survey, these facts will be more thoroughly elucidated, and treated of at length.

Toward the southwest some small outbursts of volcanic material appear to have taken place, but their extent was limited, their flows of small dimensions only. Local phenomena near station 10 lead to the conclusion, that after the eruption was passed, a subsidence took place near that point, amounting to several thousand feet. We find on high peaks, sometimes more than twenty and thirty miles distant, caps of basalt and dolerite, as well as rhyolite, that are either horizontal or very nearly so. This points, even without their lithological affinities, to a continuous flow of lava over a large area of country, at a time when the elevation was almost, if not entirely, as high as at the present day.

My purpose at present is to speak more particularly of the mining region of the San Juan district; I shall therefore abbreviate these more general remarks upon the geology of the region as much as possible. Certain typical points were found, where the rocks of the several strata were particularly well developed, and it may be of use to give a synopsis of their mineralogical constitution.

The rocks of No. 1, as found on White Earth Creek, and a number of other localities, are very readily recognized by the peculiar texture and structure. In color they usually vary from a white to light yellow, gray, greenish into green, red, brown, and sometimes almost black. On the Rio Grande, near Lost Trail Creek, the development and exposure of this stratum are particularly characteristic. Weathering in columnar masses, their general appearance is not unlike many of the "monuments" of the Pike's Peak region. Many colored strata succeed each other, nearly horizontally deposited. Mainly feldspathic material, decomposing on the surface, composes the rock, while the colors are produced by oxidized compounds of iron. Small elongated crystals, of a dark-green hornblende, and colorless crystals of sanidite are dispersed throughout the paste. Some strata, more particularly the upper ones, show a fine-grained ashy color and texture, while others present the appearance of having been redeposited by water. No. 2 shows colors in which the lilac and light brown-tints are predominating. The paste is compact, sometimes slightly vesicular, with numerous small crystals of sanidite dispersed throughout. Small six-sided prisms of black mica are associated with it, as well as crystals of a splendent brown mica. Along the Rio Grande, below Lost Trail and Pole Creeks, this formation is particularly well developed, and its strata can often be traced for miles. At some localities the sanidite is adularizing. In the upper portion of No. 2 bands or nodules of a porphyritic pitchstone are found, imparting to the bluffs a "tigered" appearance. Black mica and sanidite are the segregated minerals. Between stations 21 and 22 a stratum of this peculiar rock can be seen exposed for a distance of about three miles, having a thickness of two to five feet. These occurrences are characteristic for the upper No. 2 and lower No. 3.

The colors of No. 3 are usually darker than those of the preceding group, and it can readily be divided into two divisions. No. 3 lower shows a laminated texture, the laminæ being horizontal in their original position. A great many sanidite crystals are found in it, and but few of mica. Paste is somewhat vesicular, more so on the surface than on a fresh break, as there the vesicles are formed by the decomposition of sanidite. No. 3 upper contains less sanidite, more mica, and gen-

erally shows lighter colors. Near station 21 the changes, as we go higher, can be admirably studied. At a number of points a coarse conglomerate appears in the upper portion of this group, but I had no opportunity to study it carefully. Higher up a series of strata occurs, altogether from 400 to 600 feet in thickness, which generally show little but a compact paste, without any segregated minerals. Probably this character is due to having been reheated by the superincumbent volcanics. On some of the higher peaks, near the Rio Grande, this series is well developed, but may be regarded as a local phenomenon.

By far more varied than the three preceding divisions is No. 4, the stratum that reaches its best development in and northeast of the Baker's Park region. Within quite inconsiderable horizontal and vertical distances the rocks of this group show great variation in their lithological character. Oligoclase and another triclinic feldspar, that may be andesite, generally replace sanidite, although the latter is not entirely wanting. Mica is almost entirely wanting. As a rule the stratification in the higher members of No. 4 is very distinct, less so in the lower ones. On Handie's Peak, station 14, near the headwaters of Lake Fork, this formation is particularly rich in varieties. As a rule the paste is of a dark bluish to maroon color, sometimes with a greenish tinge, while the feldspars contained in it are yellowish. Small crystalline fragments of compact feldspar are frequent in the higher strata of this peak, and it is they that usually impart the greenish color to the rock. They receive their color in turn from a percentage of protoxide of iron. Near the summit is a band of whitish rock, about 200 feet in thickness, that appears like a matrix without any segregated minerals. Descending in a vertical line, the changes of texture are more apparent still, until the "red stratum" is reached, which serves as a very welcome geognostic horizon. It is an aggregation of feldspathic material, containing innumerable minute crystals of pyrite, at some localities crystallized sanidite; at others, small crystals of hornblende. When perfectly fresh, it is white, but soon turns yellow and red. Of the rocks containing the lodes I shall speak hereafter. Above these four groups we find rhyolite and basalt at some points.

Traveling up the Rio Grande, toward Cunningham Pass, a prominent red peak may be noticed on the north side of the river, about three miles west of Pole Creek. The red color appears to have originated from one stratum, and is gradually lost toward the base. Near the headwaters of Lake Fork, station 12 is located. To the northwest of this station a high ridge extends for some distance, remarkable for its brilliant red color. All along Mineral Creek, which flows into the Rio Animas at Baker's Park, the same colors can be observed. An extension of this is found on the group of mountains on which stations 27 and 28 were made, and near the edge of the mountains toward station 34.

It is a well-known fact that pyrite, upon decomposition, imparts to rocks and the sediments of water a color identical with the one observed in these four localities, and it seemed highly probable, therefore, that this too was owing to the same cause. Inasmuch as the decomposition of this mineral progresses rather rapidly, it may be difficult to obtain, without much work, the proof of the supposition. On Mineral Creek, however, specimens were found that were a grayish white, containing in part perfectly sound pyrite, in part the same mineral having undergone more or less decomposition. In the latter case, the very minute crystals were surrounded by a brown or red stain, produced by the secondarily-formed hydrated sesquioxide of iron. At another point, station 15, east of the headwaters of the Rio Animas, it was observed

that all the rocks of the higher volcanic strata, reaching nearly to the middle of No. 4, contained numerous small particles of pyrite but little decomposed. The red stratum, a sit was named for convenience' sake, is therefore a stratum of volcanic rocks, thoroughly impregnated with pyrite. In those portions where ore-bearing veins have been found, and are worked, I have observed no such impregnation, if we except a few lodes on Mineral Creek, but even there they are below the red stratum. This fact, unimportant as it might seem at first glance, has a weighty bearing upon the consideration of the ore-veins that have been found in the country that we examined.

At the time of my visit at the San Juan mines, August and September, 1874, but comparatively little work had been done. The greater portion of the miners' time and energy was devoted to prospecting, and but a few had then developed their lodes to any extent. One difficulty under which they labored was the want of available capital, and of a place where the ore might readily be converted into cash. It would be impossible to give any fair estimate of the number of men scattered over the country there, but I think that usually given is too high.

Mining is carried on at several points in the vicinity and on tributaries of the Animas River. Near its head, at the so-called "Forks," is a complex of lodes, (one of the early discoveries,) and from it the locality has received the name "Mineral Point." Traveling down the river for a distance of about six miles Eureka Gulch is reached, another locality considered by the prospectors as very promising. A settlement has been made at Howardsville, on the Animas, this being a point more favorable, perhaps, than many others, having the additional advantage of being centrally located with reference to the mines. At the bend of the Animas, near the base of Sultan Mountain station 26, is Baker's Park proper; there is a settlement called Silverton. A short distance to the east of Silverton is Arastra Gulch, which became well known some years ago by the discovery of the "Little Giant" mine, and now contains a number of others. In a similar position to Howardsville is Cunningham Gulch, with a number of promising lodes, as yet comparatively undeveloped. Besides these points, prospecting and mining to a small extent are carried on throughout the entire vicinity, both on the mountains and in the cañons. Smelting-works were in the course of erection at Silverton when visited by our party, but, as I am informed, were not completed satisfactorily.

Geognostically, the northern portion of the district just described shows scarcely any important variation from the general character of the surrounding country. All the rocks of that part, so far as I have had occasion to observe, are volcanic, exhibiting, as at many other neighboring points, a great variety in texture and mineral constituents. From stations 13 and 14, the No. 3 of our schedule, above given, extends west and southwest, changing in lithological character, although the stratigraphical relations remain simple. I am inclined to attach considerable importance to this latter feature, all the more so, inasmuch as a satisfactory explanation of the geological relation could otherwise only be obtained after very careful detail studies. The rock upon which station 15 is located, is of a grayish to muddy-green color, containing small, irregular fragments of a triclinic feldspar, and some sanidite. Cubical pyrite crystals, of about 0.3^{mm} edge, are dispersed throughout the rock, giving it, upon decomposition, a brown color.

Similar in general character, but varying in detail, are the rocks composing the mountains on either side of the Animas down to Silverton, and a short distance beyond. They are mainly aggregates, as

those from station 15, sometimes containing pyrite as an impregnation. In Cunningham Gulch the lower portions are of a dark-gray color with a greenish tinge, while the higher portions of the hills bordering the cañon are capped by the bluish strata of the higher No. 4, as described above from Handie's Peak. In Arastra Gulch the rock containing the lodes higher up on the mountain-sides closely resembles that of station 15 at some points, while at others, without any great change in the vertical direction, it answers more to the bluish variety. From all that I could observe, however, I have come to the conclusion that the lode-bearing rocks of Baker's Park belong to that trachyte series which has been designated as No. 4.

This feature of regularity disappears when we reach Cunningham Gulch. Traversing the cañon, whose walls rise 3,500 feet above the creek, it will be perceived that the dark colors of the rocks still predominate, but that the lower portion of the steep walls has a tinge of gray and green, and is not horizontally stratified. This might, upon a cursory examination, lead to the conclusion that the lower rocks, showing weathering in a vertical rather than horizontal direction, were columnar trachyte. A short distance below the elevation at which the "Highland Mary" and several other lodes are located, a sharply-marked horizontal line may be observed, very slightly inclining toward the west. Above that line the rocks are horizontally stratified, varying from a bluish to a maroon color—the trachyte No. 4.

Proceeding to the head of Cunningham Creek, the volcanic rocks are seen only as forming the crests of ridges, while the main drainage runs over metamorphic rocks. Station 17, near the head of the creek just mentioned, is located on gneiss, and may be regarded as one of the outposts of the metamorphic area already mentioned. From there the line of outcrop extends east and southeast on the one side, west and south on the other. Local accumulations of mica or quartz change the lithological character of the rock, and the appearance of chlorite in it gives rise to a continuation of the metamorphic area to the southeast as chlorite schist, the rock composing the lower portions of the Cunningham walls, and containing a number of ore-veins. Further down on the Animas, where these metamorphic rocks should be expected to crop out, within a few miles below Baker's Park, on the Animas cañon, we find nothing but volcanics. Along either side of the river, from Cunningham Gulch downward to the point just given, volcanic rocks appear to form the entire mass in view. Although the lower portions of the rocks exposed probably do not belong to No. 3, it is very difficult to identify them with any one of the underlying groups, and they must be referred to a position near to or in intimate connection with No. 4. Owing to a large quantity of *débris* in Arastra Gulch, the majority of lodes thus far discovered have been claimed at an elevation of more than 1,000 feet above the creek. At no point in that gulch have I observed cropping out of metamorphic schists, although I have reason to believe that they really do underlie the volcanic material. This suspicion is based upon the character of the Little Giant ore, which contains chlorite and none of the minerals mostly found in the trachorheites. Prospecting has also been done farther down the river, but as my time was limited, I had no opportunity of visiting any of the lodes there located.

The conditions on the west side of the Animas appear to be of a more simple character, the metamorphic rocks not reaching over in such a manner as to crop out, although at some depth they may probably be found. It is possible that considerable erosion took place before the volcanic flows invaded the regions, and before the lodes were formed—

a view which is supported by the fact that near the head of Cunningham Gulch a light blue to white limestone crops out, which, according to its lithological character, must be referred to the upper Silurian or lower Devonian of that region, no fossils having been found that might establish its age beyond a doubt.

The metamorphic rocks of that region, in which stations 23, 25, and 38 are located, show many variations. From a pure quartzite they pass over into micaceous schists, into gneiss, and at some points into a coarse-grained granite. Schists occur that contain the characteristic staurolite twins, scarcely to be distinguished from some northeastern localities. Numerous small and large veins of white quartz traverse these schists, showing sometimes slight indications of ore.

In speaking of the lodes of the region under consideration, it is necessary to state that but little work had been done upon them; that there are existing no mines of any considerable depth; and that but very little time could be spent upon their inspection. These facts exclude the possibility of deciding with any considerable degree of accuracy the character of the ore-bodies at any greater depth. It was necessary to make almost all studies on the immediate surface; and as from a series of such observations no law can be derived exhibiting the ratio of development as compared to the depth, it stands to reason that none definitively to be relied upon can be here given. The geological character of the veins under consideration is a very interesting one, and I believe that the data regarding development, with depth of the mines, must necessarily afford much information on the distribution and formation of ore-bearing veins in general.

OCCURRENCE OF LODES.

Two systems, chiefly of lodes, are found, the one striking approximately northeast to southwest, the other northwest to southeast; and the two directions may be observed to occur at the same places, producing a crossing of the veins.

At all points, where none but the volcanic rocks crop out, the veins run through them in a very regular course, showing but few deviations from the straight line. Often quartz veins, containing but little ore, were observed from our high stations some distance off, keeping a regular course at times for more than a mile. As the quartz is harder than the surrounding rock, it stands out prominently, while the former, immediately adjacent, is weathered off. Decomposing pyrite imparts a brown color to the projecting ledge. As a rule, the walls may be pronounced well defined, although near the surface atmospheric influences would have the tendency to render them less so. Frequently the veins can be seen along the face of a rocky hill for several thousand feet. This was the case on a mountain opposite Howardsville, where a number of veins, some of them claimed, are visible for a vertical distance of more than 2,000 feet. From the north side of the summit five parallel veins traverse the trachytic rock for a vertical distance of 1,200 to 1,400 feet, and are in their turn cut by a large vein starting from the southern side, the "Mammoth lode." Farther to the south, beyond the last named, there are several smaller veins, having an almost vertical dip. *Debris* covers the lower portion of the veins, hiding them out of sight. In Cunningham Gulch the lodes, after first running through the metamorphic rock at right angles to its strike, enter without apparent disturbance or dislocation the horizontally stratified volcanic cap. At the shallow depths which have thus far been reached, no change in the character of the ore could be

observed. The stratification in Arastra Gulch is not so well marked, the rocks showing a more massive structure, although a few miles beyond its head they are regular again in their occurrence. Numerous other lodes already located occur in the volcanic rocks. The strike approximates to that above indicated. No definite relation, however, of their course to the structure of the rocks containing them could be observed.

Mineralogically speaking the veins belong altogether to one system, with the exception of a few in Arastra and in Boulder Gulches, of which mention will be made hereafter. Minerals of a relatively low degree of volatilization form the main bulk of the ore, others, however, not being wanting.

The persistency of the veins in a vertical direction is a matter of importance, where nothing can be learned by the study of artificial depths. It appears to me that it may be regarded as a rule that wherever *débris* or some other similar cause does not obscure the view of the outcropping vein, that vein extends to considerable depths. About seventy-five lodes were located on Mineral Point, showing very promising ore from the surface downward. Sufficient work to retain the claim had been expended upon quite a number of them. Several gentlemen, G. W. Kingsbury, J. R. Hanson, A. W. Burrows, C. H. McIntyre, all from Yankton, Dacotah Territory, and W. H. Van Gieson, P. Houghton, and S. H. Tuttle, from Whitewater, Wisconsin, were continuing the prospecting as well as the further developments of the veins already claimed. On Mineral Point the main strike is northwest to southeast approximately, although several lodes cross each other, and others occur, striking from northeast to southwest. As a rule, the width between walls may be stated at 4 to 12 feet, but larger veins occur. The ores mainly found are galenite, middle to fine-grained, containing silver, sphalerite, from light yellow translucent to the brown varieties, pyrite, chalcopyrite, and fahlerz, (brittle silver,) which throughout that region appears to be an antimonial tetrahedrite, containing mainly sulphur, antimony, copper, and silver, replacements being produced by iron and zinc. About 8 to 13 per cent. of silver may be regarded as the limits within which it occurs in the pure mineral. This variety of tetrahedrite has been distinguished as freibergite.

The gangue appears to be mainly quartz. As some of the locations of that section, belonging to Eureka district, I would mention Dakota, Mineral Point, Red Cloud, Little Twinkle, Mastodon, Bond Mine, and Equator. One of the lodes on Mineral Point shows a manganese deposite on the surface, (psilomelane,) while farther down galenite forms the main body of the ore.

In the Placier Gulch, Burrow's Park, Adam's Park, and at the head-waters of the Uncompahgre a number of lodes have also been located, showing ores similar to those from Mineral Point and the immediate vicinity.

Upon the mines of Eureka Gulch no date could be obtained, owing to a lack of time.

Descending Cunningham Gulch, Galena Mountain is found on the right hand, while Kendall Mountain is on the left. Near the head of the gulch and on either side lodes have been located, and worked to some extent. As above mentioned, the lower portions of the cañon consist of chloritic schist, stratified, but standing on edge; while the upper portions are formed by the bluish volcanic rocks of No. 4. Several well-defined veins extend from the lower to the upper, and, as I was informed, the continuation had in two instances been traced beyond the ridge of the mountain to

the other side. A considerable amount of *débris* precludes the possibility of following the veins to the bottom of the gulch, but, judging from analogy, they may be considered to extend some distance farther down beyond the point where at present they can be seen. This cañon now being the main route of ingress and egress to and from Howardsville, prospectors have been attracted more particularly to the study of its vicinity, and ore has been obtained from several veins, yielding, even when taken from the surface, a comparatively large percentage of silver.

Near the head of the gulch, on the left hand descending, the

HIGHLAND MARY

is located. It has a strike of north 68° west, and vertical dip. Between walls the gangue and ore average from 4 to 5 feet. To the northwest the extension of the vein has been found and claimed as the "Robert Rruce." Toward the gulch the Highland Mary runs through the horizontally stratified trachytes of No. 4, corresponding in character to that described from station 14, of a bluish color. The line of junction between this volcanic rock and the underlying metamorphics is well marked and readily distinguishable. Without showing any change in course or width, except a slight deflection of about 3 feet, forming a curve at that point, the lode can be traced downward through the schists for more than 200 feet in a vertical line. These schists are of a green color, weathering very dark. Quartz and chlorite constitute the two predominating minerals. Pyrite occurs scattered through. Structure is slaty, with small veins of quartz traversing at right angles to the plane of the schists. After that *débris* sets in, and it would require some tunneling or other work of a similar nature to reach the vein. Galenite, intimately associated with fahlerz, (tetrahedrite,) at many points forms the main body of ore, and pyrite, sphalerite, and chalcopyrite are not wanting. Quartz mainly composes the gangue. The ore occurs in seams, from the thickness of a needle to 9 inches, without, however, showing any symmetry of arrangement. No further work had been done at the time of my visit than the uncovering of a number of points along the vein, in order to demonstrate the continuation of ore. It is claimed that the extension to the southeast across the cañon has been found, but I did not visit the locality.

THE ROBERT BRUCE,

as above mentioned, is the northwestern extension of the Highland Mary, keeping nearly the same course. It has been prospected for some distance, and the character of ore appears to vary but little from that found below, although the distribution of the several minerals may not be the same.

THE COMSTOCK LODE,

formerly called the Mountaineer, is situated on the same hill, about half a mile nearer to the head of the gulch, and south of the Highland Mary. Its strike is a more westerly one—north 75° west. As far as could be observed, it runs entirely in the blue trachyte. It may be, however, that the downward continuation is merely obscured by *débris*, or rather large masses of broken rocks. Between walls it is on an average 4 to 5 feet wide, and has a slight dip to the south. Very little work has been done on this lode, and mainly surface-ores, consisting of galenite, pyrite, &c., have been obtained.

THE YRETEVA

is located opposite the Highland Mary, on the east side of the gulch. It strikes a few degrees more to the west than the latter, and has the schists as wall on either side. Farther down the cañon, on Green Mountain, the

GREEN MOUNTAIN LODE

is situated, striking almost north 45° west. Lower down it runs through the schists, cutting the strike of the latter at an angle of about 80°. It continues upward through them, and enters the trachyte, without showing any perceptible change of course. The ore of all the lodes in Cunningham Gulch are of the same mineralogical character, notwithstanding the quantity and distribution of each specific mineral may frequently vary.

THE PRIDE OF THE WEST

is also located on Green Mountain, and has an approximate course of north 45° west. Though it cannot with certainty be said to reach down into the schists, this yet appears very probable. Three hundred feet above the Pride of the West is the Equator; 150 feet below, the Astor; both running nearly parallel with the first.

Besides these, there are a number of other lodes on the Cunningham already claimed, but it was impossible to obtain notes on them all, inasmuch as the inspection of each would require nearly an entire day. This latter fact is owing to the distance at which the mines are located from any available camping-place, and from the fact that, besides being far apart, they are mostly at a considerable elevation above the creek.

We have in the Cunningham a series of silver lodes, which, so far as surface-indications may be relied upon, do not change the character of their ore when leaving the one and entering the other geognostic formation. At another locality, of which mention shall presently be made, veins containing gold-ores are found. Higher up the mountains veins appear, carrying very small quantities of this metal, but showing specific silver minerals.

In Arastra Gulch, about two and a half miles down the Animas from Howardsville, at the mouth of Cunningham, gold-mining was carried on first. The gold was washed out by various methods, until the "Little Giant" was discovered. This discovery led on to prospecting, and after some time a large number of veins had been found and claimed. In former times the settlement there was one of good promise. It decreased after the abandonment of gulch-mining, but, under the influence of these newly-discovered silver lodes, is again reviving. Although I spent as much time as I could upon the decision of the question whether the metamorphic rocks underlied the trachytes containing the lodes, I could find no point where a satisfactory outcrop occurred. Judging, however, from the close proximity of these rocks, from their trend toward the region under consideration, and from the fact that the ore of the Little Giant is associated with chlorite, being one of the lowest mines in the gulch, I think it highly probable that they do extend through and that the veins probably run through into them. The veins observed on the higher portions of the mountains forming the walls of the short cañon run in trachyte, belonging to No 4, have as a rule a course of east 10° to 50° south. A number of veins occur that vary from this, but the majority preserve a parallelism among themselves. At the same time they show no material deflection from the course of neighboring veins.

THE LITTLE GIANT,

as stated, is a gold-bearing vein, situated on the northeast side of Arastra Gulch, with a course of about north 40° west. It is well known as one of the oldest mines of the region, and has yielded profits. A tunnel is driven in from the southwest, striking the lode. A short distance from the mouth of this tunnel crushing-works have been erected, crushing the ore to a powder, and as such it is then treated by amalgamation. Central and Dexter are two gold-mines east of the Little Giant.

On the opposite side of the creek, Hazleton Mountain rises to a relative elevation of 3,600 feet, and it is upon the north and northeast face of this mountain that a number of lodes are located.

EXCELSIOR LODE.

Upon this lode more work has been done than upon most others. A shaft 30 feet in depth was sunk, and a quantity of ore taken out, now forming a small dump at the mouth of the shaft. Its course is east 39° south, and the width between walls 3½ feet. On either side the walls, even at that slight depth, are well defined, and composed of trachyte, belonging, as in Cunningham Gulch, to No. 4. The ore mainly consists of galenite, middle to fine grained, sphalerite, pyrite, chalcopyrite, and fahlerz, almost identical with the tetrahedrite mentioned above.

THE PROSPECTER

is another lode, near the preceding one, having a strike of east 31° south, and a dip of 18° to the southwest. Wall-rocks on either side are the usual trachyte, and the ore analogous to that of Excelsior.

THE PELICAN LODE

has a course of east 54° south, with a dip of 15° to the southwest. Two shafts of 18 feet each have been sunk upon the lode. For 1,500 feet the outcrop has been followed and unstripped. Among a number of other lodes that might be mentioned are McGregor, east 36° south, with a dip of 30° southwest; Aspin, east 55° south, having reached a depth of 40 feet, a shaft sunk on the lode; Pathfinder, east 30° south, curving a little southward in its course.

A tunnel has been driven from Arastra Gulch southwestward into the north face of Hazleton Mountain, with a view to cutting some of the lodes cropping out on the surface. Work is being pushed at the above-mentioned mines, although but few hands are being employed. The general character of ore is similar to that of the Cunningham mines, with the exception of those located lower down in the cañon. Other lodes are located in different portions of the gulch, but I had no opportunity to visit them.

Boulder Gulch is situated opposite Arastra, on the north side of the Animas, and contains one lode, the Crystal, that shows gangue-rock very similar to that of the Little Giant. In so far as this can be taken as an indication regarding the possible presence of the schists at some depth, it is important. Gold is the main paying metal in the Crystal.

Several localities occur, besides those mentioned, where prospecting has been done and lodes have been opened.

On Goodwin Creek, about seven miles above its junction with Lake Fork, a number of veins have been claimed, and ore was taken out. On the 15th of June, 1874, the

BIG CASINO

was located at that point on the south side of the creek, and a shaft sunk. The vein runs entirely in trachyte, which is thoroughly impregnated with pyrite. Ore has been found from the surface down, composed of galenite, sphalerite, pyrite, and fahlerz. The gangue-rock, as usual, is quartz. On the other side of the creek, the

OURAY

is situated, yielding ore of the same character, running in the same rock. Both lodes have good walls, and are worked for silver.

Near Baker's Park, on Mineral Creek, about four miles west of the park, is the Silver Court, having a strike of about north 80° east. It is situated approximately at 1,000 feet above the creek, and shows the usual ores of that region.

It may be of interest to mention that near Lime Creek, some distance down the Animas, proceeding from Baker's Park, there has been prospecting done for chloride ores, in the Devonian limestones of that region, although without any decided success. Almost all the mountains in the immediate vicinity of Baker's Park, and the regions north of it, contain veins; frequently, however, without the remunerative metals. They have been found of almost incredible width, and extending, well defined, for miles. In a country where so large an amount of mineral substance is present as in that which formed the field of our labors during the summer of 1874, it cannot be astonishing that veins or even ores should be found at any place where the conditions for their segregation and accumulation were in the least favorable.

Owing to the rugged character of the country, to the sharply cut walls, inclosing cañons of considerable depth, and lastly to the regularity of the veins in course and dip, mining can be carried on at comparatively slight expense should the veins eventually prove as remunerative as their surface indications might justify us in presuming. A well-regulated system of sinking shafts and driving tunnels, either to or on the same vein, would afford facility for the regulation of water and air, as well as for the first transportation of ore, that ought not to be overlooked. Frequently the same vein can be taken in work from above in a vertical direction, while 1,000 feet below a tunnel driven will afford the facilities above indicated, besides furnishing valuable information as to the constancy of the ore, both in character and distribution. Timber exists in sufficient quantities to last for many mines. One unfavorable circumstance is the short duration of the season during which active work near the surface can be accomplished. After the mines have reached a certain development, so that their interior will be but little affected by the outside influence of atmospheric changes, a great portion of this trouble will be obviated.

In summing up all that has been observed during the short time that could be allowed for investigation of this interesting mining-region, it becomes necessary not to overlook the difficulties that had to be overcome. Above all, the fact that all the mines were but in their infancy will tend to cast a shadow over the conclusions that may have been drawn with reference to many important features. In consequence of this fact, no reliable data with reference to the vertical distribution of the ore can be given, and, although outcrops along numerous points of any lode may everywhere show favorable indications, nothing but a future development of the new mines can disperse all doubt. Regard-

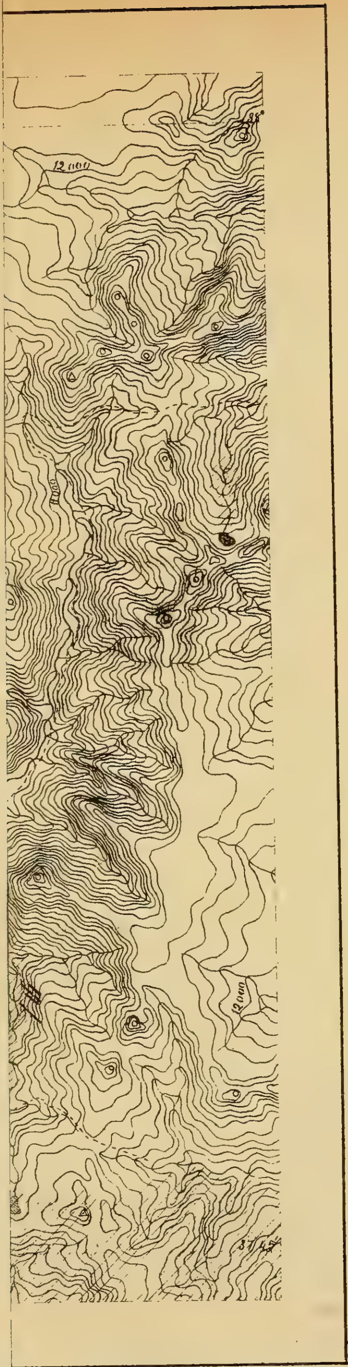
ing the persistency of the veins in a vertical direction, a sufficient number of observations have been made to lead to the conclusion that their general character in that respect is satisfactory. The ores contained in the veins are of such composition that they will offer no serious obstacles in any smelting establishment that may be founded upon principles that are not totally at variance with chemical and physical laws.

Geologically, the veins of our district are very young, probably having been formed at the close of the Cretaceous or the beginning of the Tertiary period. The enormous eruptions of the trachytic lava, covering a continuous area of more than five thousand square miles, must have taken place at the geological period above indicated. In the beginning of this paper particular stress was laid upon the impregnation with mineral matter of certain volcanic strata—a phenomenon that occurs over a large tract of country. This shows that at the time of the eruptions such conditions existed as were favorable to the formation of that class of minerals generally termed *ores.* It is furthermore to be observed that these impregnations occur mainly in the younger strata. Although the inference cannot be drawn that the fissures were formed at the same time, or shortly after the deposition of the trachytic lava, it is allowable to assume that at such a period the material for filling these fissures was existing near the locality where but lately so thorough an impregnation had taken place. The fact that the fissures extend, at a number of points, downward, through the older metamorphic rocks, makes it improbable that they should have been formed by contraction of the cooling masses. Singular as it may seem, these lodes are devoid of that ore which is generally classed as *surface-ore.* Immediately from the surface the perfectly fresh minerals are taken out. The gangue is hard and solid. An exception is made, of course, although only to a slight extent, by pyrite, which decomposes very readily when exposed to the action of atmospheric influences. This characteristic may be explained in various ways—by the rapid decomposition and breaking off of the wall-rocks, carrying with them portions of the gangue and ore; by the less intense effects of atmospheric agencies; by the character of the minerals composing the ore, and by the comparatively short time that these fissures have been filled. The latter view is the one that would to me appear as the most acceptable.

A difficult question arises, when a decision is to be made, as to the causes that have produced the formation of the fissures that were afterward filled. Accepting, as I have always done, the theory that volcanic or plutonic earthquakes have probably produced the larger number of all lode systems—and such we have in this case—it will be necessary to find whence came the requisite force. Along the highest portion of the quartzite mountains we have an anticlinal axis which can be traced westward for nearly forty miles, an upheaval that must have a very perceptible effect on regions adjoining. The idea at first presented itself that this might have given rise to the formation of the fissures, but evidence subsequently discovered demonstrates that long before the eruption of the trachyte this disturbance had occurred.

About twenty miles west from the center of the mining region is a series of isolated groups of volcanic peaks. The highest one of these, Mount Wilson, reaches an elevation of 14,285 feet above sea-level, be about 5,000 feet above the valley. Lithologically these groups must considered younger than the lode-bearing rock of the Animas, and must therefore have become eruptive later. It seems quite possible, that the disturbance produced by these eruptions may have resulted in the

formation of the present fissures, which subsequently were filled from that source which supplied so much mineral matter to other neighboring rocks in the form of impregnation. It is extremely difficult to decide questions of this kind, involving so many different factors, after having made any but the most complete investigations into the subject. I therefore only offer this explanation as a suggestion, without any further elaboration.



Geology by F. M. Endlich.

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Topography by A.D. Wilson

Geology by F. M. Endlich

MAP OF BAKER'S PARK AND VICINITY

Carb. Sandstone Carb. Limestone Metamorphic Cret. No. 1. Cret. No. 2. Lodes. Blank: Volcanic.

J. Bien, Photo Lith. N.Y.

REPORT ON THE TOPOGRAPHY OF THE SAN JUAN COUNTRY.

BY FRANKLIN RHODA, ASSISTANT TOPOGRAPHER.

In the following report I have adopted the very common system of describing the country in the order of our travels through it. The system is a very faulty one, but seemed to be the best possible under the circumstances. In describing a river or a simple range of mountains, the order of description is laid down in nature; all you have to do is to commence at one end of the line and follow along it. The mountains in the so-called San Juan country, however, are very complicated, and present no definite lines that may be followed in a description without leaving much untold. They appear, not in a single range, nor in a succession of ranges, but in a great mass. It was thought best to intersperse here and there in the description of topography such personal adventures of members of the party as might throw light on any features of the country or its climate.

We started from Colorado Springs on the 14th of July, 1874, taking the road leading up the Fontaine qui Bouille, and over Ute Pass into South Park. It would have been much shorter to have gone to Pueblo by rail, and thence on horse or mule back around the southern end of the Greenhorn Mountains, through Huerfano Park and Mosca Pass, and across San Luis Valley to Del Norte. But at this time of the year we knew that along the low plains the heat would be intense and the grass and water scarce. As it was we had a delightfully cool trip all the way, with plenty of grass for our animals. Our road lay across South Park, thence down the Arkansas River and across the range at Puncho Pass into the San Luis Valley. We reached Saguache on the 24th of July, and made inquiries of different persons as to the nature of the country for which we were bound; but although they were all deeply interested in the prospects of the new mines, nobody could give us any definite information. We could not even find out whether the country was made up of rugged mountains or only high plateaus. Two days after leaving this place we reached the Los Pinos agency, where the Southern Utes receive such supplies as are apportioned to them by the Government. This point was in the extreme southwest corner of the district surveyed in 1873, and was the point of beginning the past summer.

Our first station was made on a peak which had been occupied in 1873 as station 34. It is a low point, a few miles northwest of the agency, and is under 12,000 feet in elevation. Having a most beautiful day, and plenty of time at our disposal, we found it very pleasant to study the country that appeared in the southwest, in which our summer's work was to be. We could see none of the very rugged masses of mountains which beset our path and taxed our energies in the months following. What did appear to us was as follows: A little to the west of south, and not more than fifteen miles distant, rose up the high group in which station 33 of 1873 was situated, and containing several peaks ranging in height from 13,500 to near 14,000 feet. Farther around to the west, but much more distant, appeared a high pyramidal-shaped peak,

which is situated south of the Rio Grande, and is marked on the map as Rio Grande Pyramid. A little farther to the right, and still more distant, was a double-topped peak, afterward occupied as station 23, and named Mount Oso. Still farther around another distant, high peak appeared to be the culmination of a high mountain mass; this is Mount Æolus on the map. Nearly in the same direction, but much nearer, there appeared a high plateau, extending over many degrees of the horizon. Being more than twenty miles distant from us, and lying wholly above timber-line, it was a very interesting feature in the landscape. At our distance it seemed to be covered with grass; but this we afterward found was not the case. Our subsequent experience showed us that in this part of the country these high super-timber-line plateaus are very common. Immediately beyond this area was a high mass of red-colored mountains, afterward the scene of some interesting electrical experiences. A few miles northwest of this group Uncompahgre Mountain appeared, presenting on its north side the peculiar precipice which distinguishes it from all the surrounding peaks. North of this a series of ridges and plateaus extend from the high mountains to the Gunnison River.

Having made profile sketches of the mountains and drainage sketches of the water-courses in the vicinity, and having taken angles to every prominent peak, bluff, and stream junction visible, we started for camp. The next morning found us on our way to the great San Juan country, of which we had heard so much and found out so little. Our course at first lay to the southwest, along the Ute trail, which leads from Los Pinos over to the Rio Grande. We ascended one of the peaks in the small group containing station 33 of the previous season, and had a good view of the deep and rugged cañons leading outward from the center of the mass. In the several succeeding days we made stations 3, 4, and 5 on the high plateau already mentioned. From this plateau we got the grandest view of Uncompahgre obtained from any station during the summer. The full height of the great precipice stood out in clear profile. Its striking resemblance to the profile of the Matterhorn gave us a wholesome dread of it, for as yet it had never been ascended by any one, and we felt that to reach the summit might be beyond the range of the possible. The plateau upon which we stood ranges in elevation from 12,400 to 12,700 feet above the sea, and covers an area of about fifteen square miles. We rode over it on our mules, to make the stations, and found it covered with loose rock, which in some places was so rough as to necessitate long detours in going from one point to another. As in many other cases which occurred subsequently, we found this plateau covered with puddles of water, and wherever there was soil it was always boggy. On the west and north sides it was terminated by bluffs, ranging in height from 1,000 to 2,500 feet, the last 200 to 500 feet being nearly vertical. On the west side of the plateau the bluff terminates below in rolling, timbered land, which extends a little over a mile to the bed of Lake Fork. The total fall from the top of the bluff to the stream is 4,000 feet, in a horizontal distance of one and a half miles.

Having finished this part of the country, we traveled down the White Earth to the point at which it emerges from the upper cañon. Here the new road from Saguache crosses it at a small angle, and, swinging far up to the north to avoid the high bluffs, it finally turns up Lake Fork at a point about twelve miles from the crossing of the White Earth. Thence our course lay up stream, and we traveled along just west of our plateau stations and nearly under the bluffs. From a camp

just below the junction of Godwin Creek and Lake Fork we made station 8 on a point about five miles east of Uncompahgre peak. The next station to be made was on the great peak itself. In order to accomplish this, it became necessary to move with our pack-train about five miles up Godwin Creek, to a point where it is joined by a small stream coming in from the north. Leaving the train at this point, and taking an extra mule with us to carry our blankets and food, we rode with great difficulty up the side gulch, and camped at an elevation of 11,900 feet, near the timber-line. We started out early the next morning, expecting to have a very difficult climb. We were terribly taken aback, however, when, at an elevation of over 13,000 feet, a she grizzly, with her two cubs, came rushing past us from the top of the peak. Contrary to all expectations, we found the ascent very easy, and arrived on the summit at 7.30 a. m., having been two hours and a half in climbing up 2,400 feet. We found that the bears aforesaid had been all over the summit of the peak, though how they got up over one or two short but steep passages in the ascent puzzled us not a little. The summit of the mountain is quite smooth, and slopes from the brink of the great precipice toward the south. It is composed of several successive flows of lava, in horizontal position, which gives it a stratified appearance, and causes the slope to the south to appear terraced in profile. On the north the edge is sharp and definite, and the precipice so perfectly vertical, that by dropping a stone a few feet from the edge it fell 1,000 feet before striking an obstacle, as we determined by timing the descent. The bluff surrounds the peak on all sides except the narrow strip on the south end, and is about the same height all around, but not nearly so vertical as on the north side.

From here, for the first time, we were able to see the great massiveness of the mountains in our district. To the south the peaks appeared in great numbers, and in the distance appeared a group of very scraggy mountains, about which the clouds were circling, as if it was their home. Subsequently we found that they were most of the time thus enveloped. The high mountains near us covered the horizon from the east around by the south to the west. Nearly due west of us appeared a very high, sharp peak, which was afterward ascended as Mount Sneffels, and just to the south of it another high mass, bearing in its center a large, flaring patch of snow. The culminating point of this was later station 35, or Mount Wilson. Southeast of us, and about eight or ten miles distant, was a mass of peaks, filling the whole space between Lake Fork and Godwin Creek, all of a bright red color. The highest of these points is over 14,000 feet above the sea. Ten or fifteen miles to the southwest was another smaller mass of lower peaks of the same color, while in various places appeared mountains of white, yellow, and blue, all the colors being very well defined and clear. They were caused by the oxidization of iron and other ingredients of the rocks. To the north the mountains fall very suddenly down to the bed of the Gunnison; in fact, the peak is situated on the extreme north line of the Uncompahgre Mountains. Just before we left the summit, clouds came along, and we were soon enveloped. It was at this time that we experienced, for the first time in the season, the electrical phenomena which later interfered so much with the topographical work. As at this time these phenomena were not very marked, and as our experiences on all the peaks were very similar, the detailed account of them is reserved for another place. We made the entire descent that evening from the summit to Godwin Creek, where the pack-train had been left, getting the benefit of a rain before reaching camp. Up to the second day before this the weather had been very fine, but

from this time on till fall, rain commenced early every afternoon, and continued into the night. Moving up Godwin Creek, Dr. Endlich made a special examination of some of the highly-colored peaks already mentioned, while Wilson and I rode up to the head of the cañon and out upon a high and pretty extensive plateau, which extends from a high, sharp pinnacle a few miles west of Uncompahgre peak around the heads of Godwin Creek and Lake Fork to the head of the Animas. It forms the divide between these three streams and the Uncompahgre River. An area of fifteen or twenty square miles is above the timber-line. Ten or fifteen square miles have an elevation of over 12,000 feet. The timber-line here ranges from 11,500 to 11,900 feet above the sea. This whole area is covered with a very short growth of grass, which is almost entirely unfit for feed for animals. This is common with all the grass growing high up on the mountains; it is not nutritious. Unlike the plateau east of Lake Fork, this is not surrounded by bluffs. Instead of being smooth and nearly level like the former, it is rolling and cut up by gulches. The slopes down to the surrounding streams are steep, but bluffs are very rare. The ground is not very rocky, but, like all the soil at this elevation, it is very damp and boggy. A number of small lakes are dotted here and there over it, and in many places springs of ice-cold water gush out from the rocky prominences, fed by the banks of eternal snow which are scattered about in considerable numbers. In crossing this elevated region a strong west wind was blowing, and, the temperature being below the freezing-point, riding was very disagreeable both for our beasts and ourselves. Under these circumstances we were not so observant as we should otherwise have been. Still, there were so many new and interesting things about us that we could not fail to notice some of them.

The eastern half of the plateau drains out through a cañon leading northward and westward into the Uncompahgre River. We crossed its head on our tramp, and noticed that it fell very suddenly, till within about two miles of us it became a deep, narrow cañon, at which point the stream turned abruptly to the west. From this fact we were enabled to get a good broadside view of the north bluff of the cañon, and we saw it weathered out most curiously, being worn into almost all conceivable fantastic shapes, the general appearance being that of a great wall covered with niches and statuary. Time would not permit us to go closer and make a more careful examination; so we had to content ourselves with a distant view. From the headwaters of this creek we crossed a divide running laterally across the pleateau, and for some distance the drainage was into Godwin Creek, until, near the peak upon which we made our station, the water again flowed to the north. From station 10 the cañon of the Uncompahgre River appeared in all its ruggedness. From here we got a fine view of Mount Sneffels and its surroundings. We could see no possibility of ascending the peak from the east side, as it was cut up by rugged cañons and innumerable bluffs and pinnacles; these latter ornamenting all the ridges leading down from the great peak and its near neighbors.

In some places numbers of the pinnacles massed behind one another presented the appearance of church-spires, only built after a much grander style of architecture than most of our modern religious edifices. In some places two systems of vertical pillars were separated by a narrow strip of horizontal lava-flow, and served to heighten the fantastic appearance of the rock-forms. The fact that we stood on a peak four or five miles distant from the scene described will give some idea of the great size of these pinnacle-forms. A month later we had another much nearer and finer view of this same curious group from a peak several miles

southwest of us. Beyond this we saw nothing of interest that cannot be better described in the sequel.

The next day found us retracing our steps down Godwin Creek. After camping a night at the junction, we moved up Lake Fork, making a station by the way on a low point near the stream. A few miles above the junction we came to a beautiful lake bearing on Mr. Prout's map the name "San Cristoval." This is by far the finest of the many little lakes we saw during the summer. It is in the bed of the cañon, and has been formed by a slide from the east side of the stream. Judging from the growth of pines over this slide we concluded that it had taken place in very recent times, but how recent we could not determine. The lake is about one mile and a half in length, and in some places as much as a quarter of a mile in width. Several very small islets covered with willows add much to the beauty of the scene. A thick growth of pine timber surrounds it on all sides. To the east there is a tolerably easy slope back to the foot of the bluffs of the high plateau. On the west side the high mass of red mountains rises abruptly from the water's edge.

It was near the lower end of this lake that the Randolph party of artists discovered the bodies of five men the day after we passed them at this point. They are supposed to have been murdered by white men for their money. The cañon of Lake Fork is nowhere so rough as that of Godwin Creek, and the trail is quite good for the greater part of the distance to the head of the stream. After camping a short distance above the lake, and getting a good night's rest, we took an early start on one of the most curiously interesting and strangely dangerous trips of the season. We had to ride up the creek several miles before making the ascent of the peak for which we were traveling. From this fact we were thrown late and got caught on the summit in one of the afternoon storms. Intermingled with other unusual drawbacks, we had a fair share of the common but not less disagreeable climbing over loose rocks and through fallen timber; neither were events of the chase wanting to add to the great variety of incidents encountered during this eventful day. The object in view was to make a station on the highest point of the red mass above mentioned. In order to accomplish this, we had to follow up a ridge along which patches of loose rock alternating with timber, made the riding very difficult. It soon became impossible to follow the ridge any farther, and we had to cross the gorge on our left, going down 300 or 400 feet, and up again more than a thousand feet to the summit of the next ridge. Riding was out of the question, so we had to lead our mules. After getting out of the cañon the ground became smoother, and near the timber-line we rode along without difficulty, the land being very open and covered with grass. It was here that a considerable herd of mountain-sheep appeared in the distance. We saw them before they saw us, and, leading our mules out of sight, slipped through the timber with the utmost care; but before we could get in position, the sentinel of the herd, posted on a prominent point, gave the alarm, and they all instantly took to flight. Wilson succeeded in shooting one on the run. As we had had no fresh meat for two weeks, the result of the shot was very gratifying to us all.

For the rest of the ride the ground was covered with a short growth of grass, but devoid of trees, as we had passed the timber-line. At an elevation of 13,000 feet the soil ended abruptly, and from that point on, all was loose rock. Here we hitched our mules to stones, and, taking the note-books and instruments, continued the ascent on foot. This part of our work was quite easy, although the height we had to climb was nearly a thousand feet vertical. Before reaching the summit of the first

high point on the ridge, we noticed stray clouds wandering up and down the neighboring cañons, as if only waiting for us to reach the top before commencing the attack.

Seeing that it would be impossible to reach the main peak before the storm would burst upon us, we made our station on the first point. The main peak is 41 feet higher and a mile and a half distant, being connected with it by a long unbroken ridge. Had time permitted, we should probably have occupied both points as stations, but we were unfortunately prevented from doing this by the peculiar circumstances to be described. Station 12, the southern and lower of these two points, is situated in the upper bend of Lake Fork, where, from flowing in a southeasterly direction, it swings around to the east. Near the base of the peak Lake Fork receives its principal tributary from the south side, which on Mr. Prout's map bears the name of Snare Creek. This peak is the most southerly of the red group included between Godwin Creek and Lake Fork. Its height is 13,967 feet above the sea. On the north and east sides the slopes are quite steep but regular, while on the south and west the sides are very precipitous, with a fall from the summit to the valley below of 4,400 feet in a horizontal distance of one mile.

On arriving at the summit, Mr. Wilson hastily made a rough sketch of the surrounding drainage, and then set up the instrument, while I proceeded to make a profile sketch of the mountains south and west of us. We had scarcely got started to work, when we both began to feel a peculiar tickling sensation along the roots of our hair, just at the edge of our hats, caused by the electricity in the air. At first this sensation was only perceptible and not at all troublesome; still its strength suprised us, since the cloud causing it was yet several miles distant to the southwest of us. In the early part of the storm the tension of the electricity increased quite slowly, as indicated by the effect on our hair. By holding up our hands above our heads, a ticking sound was produced, which was still louder if we held a hammer or other instrument in our hand. The tickling sensation above mentioned increased quite regularly at first, and presently was accompanied by a peculiar sound almost exactly like that produced by the frying of bacon. This latter phenomenon, when continued for any length of time, becomes highly monotonous and disagreeable. Although the clouds were yet distant, we saw that they were fast spreading and already veiled many degrees of the horizon. As the clouds approached nearer, the tension of the electricity increased more rapidly, and the extent of our horizon obscured by them increased in nearly the same ratio; so that the rapid increase in the electric tension marked also an increased velocity in recording angles and making sketches. We felt that we could not stop, though the frying of our hair became louder and more disagreeable; for certain parts of the drainage of this region could not be seen from any other peak, and we did not want to ascend this one a second time.

As the force of the electricity increased more and more, and the rate of increase became greater and greater, the instrument on the tripod began to click like a telegraph-machine when it is made to work fast; at the same time we noticed that the pencils in our fingers made a similar but finer sound whenever we let them lie back so as to touch the flesh of the hand between the thumb and forefinger. This sound is at first nothing but a continuous series of clicks, distinctly separable one from the other, but the intervals becoming less and less, till finally a musical sounds results. The effect on our hair became more and more marked, till ten or fifteen minutes after its first appearance there

was sudden and instantaneous relief, as if all the electricity had been suddenly drawn from us. After the lapse of a few seconds the cause became apparent, as a peal of thunder reached our ears. The lightning had struck a neighboring peak, and the electricity in the air had been discharged. Almost before the sound reached us the tickling and frying in our hair began again, and the same series of phenomena were again repeated, but in quicker succession, the sounds becoming louder at the same time. The clouds now began to settle into the Great Cañon of the Lake Fork, and boiled about in a curious manner; here and there a patch of cloud would separate from the main mass and move about by itself. In passing over a thick cluster of pines down near the bed of the cañon, the lower parts would get caught and drag through with the greatest seeming difficulty. The different parts seemed to be affected by different currents in the air, and at times two little masses of cloud would pass each other less than a mile apart, but would soon turn aside, or rise up, or lose themselves in the great cloud that pretty nearly filled the Great Cañon and its branches. At times a portion of the mass, moved by an upward current, would rise several hundred feet above the general level, and, the force ceasing, would topple over and slowly fall back and lose itself in the general mass. The whole moved about in a chaotic manner, producing a curious effect. When you consider that the top of the cloud was not less than 2,000 feet below us, you can form some idea of the strange scene that presented itself to our eyes in those exciting times. The clouds soon began to rise up and approach us. As they did so, the electricity became stronger and stronger, till another stroke of lightning afforded instantaneous relief; but now the relief was only for an instant, and the tension increased faster and faster till the next stroke. By this time the work was getting exciting. We were electrified, and our notes were taken and recorded with lightning speed, in keeping with the terrible tension of the storm-cloud's electricity. The cloud reached us, coming on like a fog, looking thin and light near us, but densely white at a short distance. All the phenomena before mentioned increased in force after each succeeding stroke of lightning, while the intervals between strokes became less and less. When we raised our hats our hair stood on end, the sharp points of the hundreds of stones about us each emitted a continuous sound, while the instrument outsang everything else, and even at this high elevation could be heard distinctly at the distance of fifty yards. The points of the angular stones being of different degrees of sharpness, each produced a sound peculiar to itself. The general effect of all was as if a heavy breeze were blowing across the mountain. The air was quite still, so that the wind could have played no part in this strange natural concert, nor was the intervention of a mythological Orpheus necessary to give to these trachytic stones a voice. Having completed a rough sketch of as much of the surrounding country as was not obscured by clouds, I hastily took up the mercurial barometer, hoping to get a reading before we should be compelled to leave the summit; but, alas! too late for success. The lightning-strokes were now coming thicker and faster, being separated by not more than two or three minutes of time, and we knew that our peak would soon be struck. As I took the barometer out of its leather case, and held it vertically, a terrible humming commenced from the brass ring at the end, and increased in loudness so rapidly that I considered it best to crawl hastily down the side of the peak to a point a few feet below the top, where, by lying low between the rocks, I could return the instrument to its case with comparative safety. At the same time Wilson was driven from his instrument, and

we both crouched down among the rocks to await the relief to be given by the next stroke, which, for aught we knew, might strike the instrument which now stood alone on the summit. At this time it was producing a terrible humming, which, with the noises emitted by the thousands of angular blocks of stone, and the sounds produced by our hair, made such a din that we could scarcely think. The fast-increasing electricity was suddenly discharged, as we had anticipated, by another stroke of lightning, which, luckily for us, struck a point some distance away. The instant he felt the relief, Wilson made a sudden dash for the instrument, on his hands and knees, seized the legs of the tripod, and flinging the instrument over his shoulder dashed back. Although all this occupied only a few seconds, the tension was so great that he received a strong electric shock, accompanied by a pain as if a sharp-pointed instrument had pierced his shoulder, where the tripod came in contact with it. In his haste he dropped the small brass cap which protected the object-glass of the telescope; but, as the excitement and danger had now grown so great, he did not trouble himself to go back after it, and it still remains there in place of the monument we could not build to testify to the strange experiences on this our station 12. We started as fast as we could walk over the loose rock, down the southeast side of the peak, but had scarcely got more than 30 feet from the top when it was struck. We had only just missed it, and felt thankful for our narrow escape.

We could not follow down the ridge we came up, as, in the present state of affairs, it was highly dangerous to cross any prominent point, even though it should be much lower than the peak itself. Hail and sleet began to fall freely, and as we descended to a lower level they were exchanged for rain, with which we were well drenched, even before reaching the mules.

We found Dr. Endlich waiting for us, having just returned from the ascent of a lower point of the main peak, where he had experienced similar phenomena to those already described, only differing from them in degree. He said he had seen the lightning strike our peak, and at first thought that we might have been caught, till finally he saw us coming down the mountain.

Our mules seemed glad to see us, not because they cared one straw for us personally, but because our arrival was the signal for the return to camp. Whether they had been pestered by the electricity, we could not tell, but they were doubled up into the most compact shape that mules are capable of assuming, and did not seem to appreciate at all the romance connected with a cold rain-storm at a high altitude.

Hastily putting on the saddles, we started down the mountain-side. By this time the clouds enveloped us entirely, and rain fell almost without intermission till long after we reached camp.

On our way we loaded one of the mules with the meat of the sheep killed on our way up, but as it was a very difficult matter to tie the whole animal securely across the saddle, it gave us a great deal of trouble, as in going down steep places it would slip forward, and in going through brush it would be pulled back. To go back the way we came was such a very difficult task that Wilson concluded to take a short cut for camp, though this involved the risk of coming to bluffs or impassable slides. We had to lead our mules the whole way, which was very steep, and composed of loose rock mixed in among the thin, straight stems of the quaking-asp trees. Here and there we came to large patches of loose *débris* without any trees, and were compelled to fall

back and take a new tack. The rain was still falling heavily when the sun set and darkness commenced.

In these high altitudes there is scarcely any twilight, and darkness quickly follows sunset. I will not go through all the details of our descent, as nothing occurred beyond what has happened in the experience of every mountain-climber. We reached camp late in the night, thoroughly drenched, and had to eat supper in the rain, which was anything but pleasant.

If I could end the history of the adventures of this remarkable day by describing how we were pleasantly housed in dry, comfortable quarters, and how we contentedly "wrapped the drapery of our couch about us and lay down to pleasant dreams," I would. But, alas! how the romance would be taken out of the story if I should tell how we crawled into our low, short, and narrow little tents, with the water running under at the edges, and leaking through at the top, and how we had to lie as still as possible lest we might disturb the pools of water gradually collecting on our blankets, and precipitate them into the inner recesses of our bed-clothes. All this and more shall I leave untold, and cease to disturb the several members of the party, placidly snoring away in the babe-like innocence of their slumbers. And while they thus replenish their wasted energies with the nocturnal balm of sleep, may the unwearied mind of the reader wander like a restless ghost up and down this interesting cañon, and observe with care the high and picturesque walls of trachyte, which extend from the creek-bed to the summit of ever-memorable station 12, and wonder, it may be, at the pine-trees scattered here and there in the cracks in the rock 2,000 feet above him, having scarce a root-hold, and looking so diminutive as to suggest the idea that some Japanese had been there and applied their wonderful art to stunt them to their apparent pigmy stature. If, too, he extends his observations up the scarcely less imposing cañon of Snare Creek, he will find many more things wonderful in their nature, but too varied to find a place in such a hasty sketch as this. If the reader, after having satiated his curiosity with the many wonders of nature here laid out before him, will return from his wanderings to the camp he left the night before, an interesting scene will soon present itself to his eyes. If, a little before the break of day, he observe closely the tents of the several sleepers before mentioned, he will soon observe a movement in the one occupied by our huge black cook. That little circumstance marks the dawn of the next fiscal day, even though the first object emerging from the tent be as black as night. In all countries it is a recognized fact that the darkest part of the night comes just before the dawn, and the present case tends to confirm the truth of the adage. The morning is bright and clear, but all things not under close cover are wet, and wood is no exception to the rule. The cook searches about under trees and bushes till he has collected together an armful of tolerably dry branches, and then makes the fire. The fire burns, and another era in the cook's existence has commenced. He takes four sheet-iron pots, all of different sizes, and starts for the creek. A man of less muscle would content himself with two. He soon returns with all the vessels filled with water, and places some of them on the coals to heat, one for the coffee, the others for cracked wheat, hominy, or other article. At this stage of the proceedings there is some commotion in another tent, and presently the two packers emerge from their cover fully equipped for the day. One immediately starts out to hunt up the mules, while the other puts the packs and aparejos in order. The cook proceeds to bake his bread in a Dutch oven, while the rest of the party still snore on.

In the intervals of his cooking he opens the mess-boxes, sets them about four feet apart, opens out the leaves, and, placing a support under the middle, spreads his cloth, and the table is ready. A short time before everything is ready he rings the first bell for breakfast, by yelling out, in the barbarous mountain dialect, "Grub pile!" or sometimes simply "grub" for short. At this there is great commotion, and the rest of the crew "pile out" in all sorts of shapes and in all states of nudity. They hurry, for there is no driver like hunger, and they now feel a yearning in the inner man that cannot be repressed, and their love of sleep itself gives way. A general rush for the nearest water soon takes place. In a few seconds all are washed, and immediately commence the attack on the breakfast-table. They make short work of it, and at 7 o'clock all are in their saddles and off.

Following the trail up the creek, we found it very rough, but at a point west of station 12 the bed of the cañon widened out, and from there our riding was quite easy. Leaving a notice on a tree near this place, for the train to encamp, we ascended a low peak to the south and west of the creek. From this point we succeeded in clearing up some points in the topography which had been unavoidably missed from station 12. Two miles west of it was a very high, massive mountain, with a great horizontal band of white running across the face of a high bluff on the northeast side of the peak. This mountain bears on the map the name of Handie's Peak, and was ascended the day after this as station 14.

From station 13 we had a splendid view of the red mass to the north and east, station 12 being the nearest of all the peaks. The last 2,000 feet in height was composed wholly of dull-red *débris*, with very few bluffs. Here appeared some of the finest mountain forms any of us had ever seen. From our distance, which was several miles, the individual stones were all lost to the eye, and the slopes appeared as if they were made of red sand, but of course having the forms which naturally result from coarse *débris*. The tops of the ridges were nowhere jagged, but were invariably formed of gracefully-flowing curves, while mountain-lines could scarcely be more beautiful than the magnificent sweeps of the curves formed by the long *débris* slides. Except on the south and west sides of station 12, these curves were nowhere broken by any considerable bluffs. Having reached this station early in the morning, we were not troubled with storms during our work.

Several large silver-bearing veins crossing the ridge near this station gave us the first intimation of our approach to the mining region. We descended to camp, which we found just at the base of the peak, and arrived quite early in the afternoon. The next day, August 14, we moved up stream, leaving directions with the packers where to make camp. We rode up a small creek coming in from the south, which drains the basin between station 13 and Handie's Peak. The ground most of the way was very miry, and the brush and timber very difficult to pass through. After passing the timber-line, the only difficulties in our way were the boggy ground and rocks. One or two very steep slopes, along which we had to ride, were very disagreeable; but much less so for us than for the poor donkeys. At an elevation of nearly 13,000 feet we found a grassy patch of ground, which was large enough and level enough for our mules to stand on without much danger. Having secured them to the rocks, we climbed up the peak, which we found a very easy matter, as the total rise was scarcely a thousand feet and the slope quite gentle. A short distance below the summit, at an elevation of about 13,500 feet, we found some shallow prospect-holes sunk on a vein which cut transversely across the ridge. As yet we had seen

none of the miners, but these holes, with the accompanying notices written on a stake, indicated their presence somewhere in the vicinity. We soon reached the summit of Handie's Peak, and found it not near so acute as most mountain-summits in this region. This peak is very massive, with high bluffs on the east side, which continue along the east ridge around to station 13. Between the two stations is a deep basin, amphitheatrical in form. To the south and west the slopes are steep, but not precipitous.

To the west, and several thousand feet below us, we saw several little lakes of a bright emerald-green color. We had no opportunity to make any investigations as to the cause of the color, but from observations later in the season we concluded it must be due to vegetation at the bottom of the lakes. The white band already mentioned as appearing on the east bluff was found to be composed of volcanic ash. Here, again, we saw a band of sheep, but having left our guns at the mules we could not shoot them.

Early in the day we noticed the clouds hovering about the quartzite peaks, as we had seen them so often before. They never completely veiled all the peaks of the group, but early each day began to circle about them in a restless sort of a way, like so many mighty lions about their lair. To us this apparent restlessness suggested a consciousness of their terrific destructive power, which only awaited a mandate from the "God of storms" to be set in motion. We even now held those peaks in awe, as there seemed to be established somewhere in their midst a regular "manufactory of storms." Our subsequent experience among them never completely obliterated this idea. About 1 o'clock in the afternoon the clouds again came on, accompanied by hail and electric phenomena similar to that previously described. We could detect the electricity in the air long before the clouds reached us by holding our hands high in the air, when a faint clicking was audible.

The phenomena were precisely similar to those experienced on station 12, but having reached the summit earlier in the present case, we were able to leave before it became very dangerous. Just before leaving the top I slung the strap of the tripod over my shoulder, and experienced a sharp pain at the two points where the tripod touched me. Otherwise the phenomena were much the same as on the previous station. This peak is 13,997 feet above the sea, and 30 feet above station 12. After the hail and rain commenced it did not stop till far into the night. The following day we crossed the pass from the head of Lake Fork to the Animas. The elevation of this pass is 12,540 feet. The ground up to that point is very boggy and the riding disagreeable. The rise in the last mile of distance is more than 1,000 feet. How the people of Saguache ever expect to bring a wagon-road up this I cannot see. On account of the surrounding bluffs there is very little opportunity to wind the road up it, while the miry nature of the soil will require vast sums of money to be spent after the grade is obtained before the road can be made passable. The fall from the pass down to the Three Forks of the Animas is very sudden. Leaving the train to proceed to Howardville, wherever that might be, we climbed up a peak on the north side of the trail. This point commands the headwaters of the Animas, and is 13,675 feet in height. We succeeded in getting a few of the most necessary details of the topography, but as we had traveled a considerable distance since morning, it was late before we reached the summit and about the usual time the electric storms again commenced. By this time the romance connected with these phenomena had all disappeared; and at this time and thereafter, whenever

our hair began to fry, we generally disappeared at pretty short notice. We never waited again so long as we had done on station 12. As we were working on the peak, peculiar sounds reached our ears from the depths of the Animas Cañon, 2,500 feet below. They resembled very much the whistle of a locomotive when heard from a great distance. By listening carefully and looking through our glasses, we formed a shrewd surmise that this strange sound was the last indrawn note of the plaintive bray of the jackasses used by the miners in bringing the ore down from the mines. The harsh lower notes had all been dissipated before they reached us, leaving nothing but the refined essence of the sound behind. We considered this as a conclusive evidence of the presence of white men, and immediately descended to our mules. The trail down to the Animas was quite steep, notwithstanding it wound around a great deal. For the last part of the distance the fall was very sudden down to the Three Forks. The total fall from the pass is 1,400 feet in two miles. At what is called the Three Forks, or the junction of the three creeks which form the head of the Animas, we found several cabins with a number of miners about, who kindly showed us specimens of ore from their various mines. As Dr. Endlich will give a detailed description of the mines, I will refer the reader to his accompanying report. A very short distance below the forks, the great bluffs of the Animas Cañon commence, at first more or less broken up by slides and by gorges formed by streams from the mountains. A little while after leaving the forks the trail crosses the Animas, and follows across the great rock-slides which come down to the water's edge on the east side of the stream. These extend many hundred feet above the trail, and are terminated above by a series of high bluffs, one receding behind the other and separated usually by small *débris* slides, similar to the great one below; sometimes very steep grassy slopes form the connection between the bluffs. Above all, a long slope, more or less steep, connects the last and highest with the mountain-peaks above, which are from 3,000 to 4,000 feet above the stream-bed, but seldom ever visible from the trail, as the near precipices cut off the view. The bluffs on the west side are for a long distance much less broken than on the east, and instead of having slopes at their bases, rise abruptly from the bed of the cañon, in many places a thousand feet, nearly vertical. But the series of perfectly inaccessible bluffs often rise from 2,000 to 3,000 feet above the stream, and are connected with the mountain-peaks by steep grassy or rocky slopes. In some places the bluffs form the abrupt termination of what from above are seen to be sharp, rocky ridges, leading down from the peaks. In the upper end of the cañon the only gorge cut through the western wall is that of Eureka Gulch. Near its junction with the Animas this is very narrow, but a short distance back it widens out into a considerable basin. A very interesting thing in connection with these bluffs is the fact that many little streams run over the top and reach the bed of the cañon by a succession of little falls. These give a picturesque appearance to these otherwise bare bluffs. Still more important is their bearing on questions connected with the working of the mines. A fall of from 1,000 to 2,000 feet could be easily obtained. It can scarcely be doubted that there is a never-failing hydraulic power contained in these little streams sufficient to work all the machinery that can ever be brought into these mines. All that is required is to apply it properly. In making this general assertion, I do not refer simply to those streams which fall over the bluffs of the main cañon of the Animas, for it must be remembered that, up Cunningham, Arastra, and other gulches, there

are hundreds of other similar streams that can be used just as well, if not even better than these.

While crossing the great slide on the trail, we could see miners at work against the bluffs on the west side of the river; curious-looking zigzag trails led up to these mines. Others were tunneling from the bed of the stream, and seemed to be in a poor position in case of a great spring-thaw, as all their work would then be wasted. At one place we saw an ice-bridge over the stream, which struck us as a novelty, for the middle of August, at an elevation of only 10,000 feet, in this latitude. At a point about five miles below the Three Forks the steep slide across which we were riding abruptly ended, and we came out into a thick clump of trees in which were several log-cabins, bearing on a flaring sign-board the word "Eureka," evidently intended for the name of a town that was expected to be, though what had been found here to suggest the name was not immediately apparent. It is not impossible, however, that the first settler coming up the Animas here found his farther upward progress barred by the great rock-slide. At this point the bed of the cañon suddenly widens out to a quarter of a mile or more in breadth, forming the upper end of Baker's Park. A great portion of the level ground is here covered by willows and swale-grass, cut through and through by old beaver-ditches. After leaving Eureka, the ground is very uneven, and quite devoid of timber, except up the sides of the cañon.

The bluffs on the west side become more and more precipitous, and less broken up by gorges; while on the east the few bluffs which presented themselves farther up stream are exchanged for steep rocky mountain-slopes, with few bluffs. At a point about three miles below Eureka the Animas is joined by Cunningham Creek, a considerable tributary, coming in from the east side. Howardville, containing at the present time some eighteen or twenty log-cabins, is situated on both sides of this stream, near its mouth. This is the first settlement in Baker's Park, and among its other attractions can boast of a store, a butcher-shop, assay-office, shoemaker-shop, and post-office. Although as yet there is no regular mail-communication with the outside world, it is expected that a regular mail-route will soon be established by the Post-Office Department. All mail is now brought in from Del Norte by occasional travelers, and letters cost ten cents besides the regular United States postage.

From this position a splendid view of some of the silver-veins can be obtained. The face of the high bluffs, west of the town and across the river, is covered with a net-work of yellow veins, extending from the bed of the stream up as far as we could see. Later we found that these same veins cropped out on the other side of the mountain, individual veins being continuous the whole distance. We found some of them crossing the highest point of the ridge at an elevation of 13,500 feet, thus giving a vertical depth for the outcrop of 3,800 feet, while the horizontal distance was not less than the thickness of the ridge, a length of from three to four miles. How much farther they may have extended horizontally, we could not make out in our limited time.

At a point nearly west of Howardville the bluffs end, and steep grassy and rocky slopes take their place and continue to the lower end of the park.

On August 16, the day after our arrival at the town, we crossed the river and ascended a peak northwest of Howardville, but not quite visible from that place on account of the intervening bluffs. The slopes were all grassy, but so steep that we could ride but a small part of the dis-

tance. We came upon the top of the ridge near a little sharp point on the spur, which I believe is the one designated by the name of "King Solomon's Mountain." Just a little below the top of this point we found a level patch of ground about 20 feet square, where we concluded to leave our mules, as such level places seemed to be rare in this vicinity. Looking about, we saw only one stone of sufficient size to hitch our animals to, and that was an oval one; but as no alternative presented itself, we tied the ropes of the two mules together, and then fastened them as well as we could to the stone. The result of this will be seen on our return.

The main peak was about half a mile to the north of us, but as the ridge was easy to walk over, we had little difficulty in reaching the top. On this peak we made station 16. Its elevation is 13,541 feet, as determined from the mean of twenty-three readings with a mercurial barometer. This point is not very sharp, but is simply the culminating point of several rocky ridges. From here a splendid view of the vicinity of Baker's Park may be obtained, although only a small part of the park itself is visible. In order to understand rightly the situation and peculiar position of this very interesting park, it will be necessary to give now a general description of it, leaving the minor details to be filled in in our future travels. From this point we can see nearly the whole of the great depression of which Baker's Park forms the most important part. Just to the east of us the Animas runs along, its deep cañon nearly 4,000 feet below our present position, but the high bluffs bordering on the west succeed in completely hiding the stream from view. Howardville is also shut out from the sight by the same obstruction, although it almost comes within the field of view. The fall from the summit of this peak to the stream near Howardville is 4,000 feet in 9,500 horizontal. Just across the river, Galena Mountain has a fall to the Animas of 3,700 in a horizontal distance of 7,000 feet, while, down to the nearest point on Cunningham Creek, the fall is 3,500 feet in 5,000 feet horizontal. On the southwest side of Cunningham Gulch the fall is even greater than this. These cases are not unusual specimens, but I have selected them because the peaks are well known and can be easily found on the map. I could instance many others where the fall was full as great and even greater. From station 16 we had a good view up Cunningham Gulch, from the fact that the continuation of the direction of the stream passed almost exactly through the station.

Along the east side of the Animas a line of high peaks extend, from its head down to the lower end of the great cañon, a distance of thirty miles. At the north end of the line, but draining into Lake Fork, is Handie's Peak, with an elevation of 13,997 feet. Next comes two nameless peaks, the first having an elevation of 13,830 feet and the second 13,770 feet above the sea. Then Galena Mountain, with an elevation of 13,290 feet. Next, Mount Kendall, 13,380 feet above sea-level. Below this for some distance lower points continue the chain, till we come to the group of quartzite peaks, ranging in height from 13,600 to 14,054 feet, where the line culminates in Mount Æolus and Pidgeon's Peak, and, falling off suddenly to the south, soon loses itself in the plains of Southern Colorado and New Mexico. The great and important feature of this region is the far-famed Baker's Park. Small in area and quite unimportant in itself, it would be utterly disregarded if situated in other parts of Colorado; but, located as it is, surrounded on all sides by the most rugged mountains in the Territory, if not in the whole Rocky Mountain system, this little area of flat land becomes an object of curiosity and interest. When looked at as the center of the great mining

district, it becomes an object of great practical importance. But not till one has crossed over the several passes leading out of it can he feel a proper regard for this little spot, so carefully guarded by nature from the invasion of man. In itself, it is nothing more than the bed of the deep cañon of the Animas, spread out at the lower end to a width of a mile or two. It extends from the little town of Eureka, already mentioned, down the Animas to the base of Sultan Mountain, a distance of about nine miles. It is divided into two parts, the upper of which is contained between Eureka and Howardville, a distance of about three miles, and is quite rolling, so much so as to be scarcely worthy the name of park. Below Howardville the cañon again contracts till within about three miles of the base of Sultan Mountain, when the cañon-bed widens out into a beautiful level piece of land, about three miles long, in the direction of the stream, and having a width of from one to two miles. It contains, in all, from 2,000 to 3,000 acres. This is the true Baker's Park; but the division between the two portions, as we have described them, is not important, and in nature not well defined. The wide part above Howardville tapers almost insensibly into the narrow part below it, but the line between this narrow part and the true park below is quite definite.

The new town of Silverton, at present containing about a dozen houses, is situated near the center of the level area, on the south side of Cement Creek, a stream flowing into the Animas from the west, and passing through the park. Bounding Baker's Park on the south is Mineral Creek, which, flowing from the west, highly impregnated with iron, sulphur, and other ingredients, hugs closely about the foot of Sultan Mountain, and joins the Animas near the entrance of the lower or Great Cañon. Almost all the water in this country is as pure as any in Colorado, but this stream is so strongly impregnated with mineral ingredients as to be quite unfit for drinking. The elevation of Silverton is 9,400 and of Howardville 9,700 feet. From our present position, looking down the valley, it seems to be completely closed up by Sultan Mountain, and the exit of the river is not visible. At the lower end of the park the Animas swings around toward the southeast, and for about seventeen miles cuts a most terrific cañon, ranging in depth from 2,000 to 4,500 feet in depth, through quartzite rock almost as hard as steel. It might have been expected that in the beginning the stream would have selected its course somewhere near the junction of the trachyte and sandstone with the quartzite. It seems, however, to have been turned by some agency another way, and so cut its course through the harder rock this long distance, without being at any point more than three miles distant from the softer material.

In order to get a true conception of the isolation of Baker's Park from the rest of the world, a thorough understanding of the passes leading out of it is necessary. First. Let me say that the ruggedness of the Great Cañon below the park is such that travel through it must long be a matter of great difficulty, though it is said that some miners have passed up from the plains on the south into Baker's Park by that route. The trail at present most traveled by persons passing between Baker's and Animas Parks crosses over the southeast slope of Sultan Mountain. At the divide this trail has an elevation of 10,460 feet, but the highest point is several hundred feet higher than this. This route is the roughest and most dangerous of any leading out of the park, and even in the best summer weather is unsafe for pack or riding animals.

The next pass is the one on the southwest side of Sultan Mountain, which has an elevation of 11,570 feet above the sea, and, though not

dangerous like the preceding, is very disagreeable, from the bogs, fallen timber, and rock-slides which beset one's way. Another is the Bear Creek Pass, leading from the head of Bear Creek to the head of the San Miguel, on the west side of the mountains. Its elevation is 12,600 feet. On the east a long stretch of fallen timber in a bog, through which the trail passes, makes travel very difficult. On the west a great rock-slide, over which the trail leads, is scarcely less disagreeable. Two passes lead over to the head of the Uncompahgre River, but, as the box-cañon of the latter bars all egress, they require no description here. To the east of our present position are the two passes at present mostly used by persons passing to and from the mines. The first, from the head of Lake Fork to the head of the Animas, having an elevation of 12,540 feet, has been already described. The other, the pass from Cunningham Gulch to the Rio Grande, has an elevation of 12,090 feet at the highest point of the trail. Over this has passed almost everything that has been brought into the park. The trail is very steep, and in the best weather is muddy, and after a rain it becomes perfectly horrible. When it is remembered that the height of a great part of the park is only 9,400 feet, it will be seen that the ascent from the valley to each of the five passes at present used will be, in feet, as follows: 1,300, 2,200, 3,200, 3,140, and 2,690. This gives some idea of the way this little valley is isolated from the outside world. This, then, is the far-famed park, named after that daring leader of his little band, who lost his life within its bounds. This is the *cul de sac* into which he and his men were mercilessly driven by the Indians, in 1862. How many fell in the massacre, how many starved or froze to death, seems even yet to be veiled in mystery. But how the present survivors ever escaped might well remain a mystery when we consider the great depth of snow that must then have covered these high mountain-passes, and that, at that date, the country was perfectly unknown. From our station 16 only the lower end of the park, including Silverton, is visible. The view of the mountains, however, is very extensive, all the high-peak stations made up to this time being plainly visible, except the first one south of Los Pinos agency. Mount Sneffels stands out boldly, about fifteen miles to the northwest of us, while about an equal distance to the east of us appears the high peak, called, from its shape and location, the Rio Grande Pyramid. Just a little east of south the quartzite peaks again stood out in their peculiar ruggedness. From this point we also had a good view of Arastra Gulch. Its upper end is a rocky amphitheatre, between 12,000 and 13,000 feet in elevation. In its center was a little lake. At the lower end of the amphitheater there is a very abrupt fall of from 1,000 to 2,000 feet down to the bed of the creek.

Having reached the summit of this peak unusually early, we had plenty of time to study the topography carefully. Just as we were finishing up the work of the station, and had commenced building a small monument out of the few stones in the vicinity, the well-known tickling sensation about the roots of our hair again commenced, and we could see its cause in the shape of a heavy rain-cloud which was slowly drifting up the cañon. We could see long dark streaks extending from the cloud to the valley below, indicating heavy rain. All rain-storms in this country, when seen from a distance, present this appearance. A continuous mist-like connection extends from the cloud to the earth, but through this are streaks much blacker than the rest. To a person unacquainted with those storms, these streaks would appear as bands of vapor, a little thicker than the rest. In truth, however, the part that seems like thin mist is heavy rain, while the black streaks are almost

unbroken streams of water. These are what are usually known in the mountains as water-spouts. We left the summit before the electricity became very troublesome, but the rain which followed we could not avoid. Packing up our books and instruments, we walked down to the place where the mules ought to have been, but where, to our amazement, they were not. Looking over the ridge, we saw the mules, still hitched together, standing on the steep east slope, about forty yards from the summit, but the round stone was nowhere to be seen. A heavy furrow through the snow-bank, near the top of the ridge, with several deep indentations in the soil below, told a curious tale. It seems that as the storm came on a strong cold wind arose from the west, which, with the accompanying rain, made the mules feel very uncomfortable, as they were on the west side of the ridge. In order to better themselves, they moved over to the other side, slowly dragging the stone after them, till, reaching the brink, the steep slope animated the otherwise inert stone with a considerable power, and it in turn took the mules in tow. Of course, as soon as they found themselves pulled they drew back, but, finding the stone inexorable, one of them moved up a step and found herself relieved of the strain, and commenced nibbling the short grass to be found in this vicinity. But what one gains the other loses. The whole weight of the stone now pulls on the second mule; but it is not in the nature of the beast to resist for long a steady and unrelaxing strain when unaccompanied by swearing. She moves a step forward, and, finding relief, goes to grazing. The first by this time has forgotten all about the stone, and, finding herself suddenly jerked, her whole asinine obstinacy is aroused, and she braces herself for resistance, but after a minute or so, finding the pulling force unaltered, and hearing no oaths proceed from the stone, she slowly comes to the conclusion that this is not a human contrivance, and moves up. Thus by slow degrees the stone pulls them down the slope, over the little snow-bank and some distance beyond, disputing, of course, each step of the way, for such, alas! have we too often found, to our sorrow, to be the nature of the beast. After reaching a short distance from the top of the ridge, the rope evidently slipped off the stone, and the latter, rolling faster and faster, could have found no obstruction to its course for full 3,000 feet down the mountain. What the mules themselves thought of their mysterious leader they never revealed; nor did we wait long in the cold rain to hear their story, but hurriedly putting on the saddles, we dragged them down that mountain much faster than the stone did; but they moved on joyfully, for they knew as well as we that they were going to camp and to grass. Their shriveled forms and backs, curved up when we first found them, indicated clearly the fact that they were disgusted with the country, and especially all of it above 13,000 feet in elevation. The rain now fell in torrents, and the grass being thoroughly wet the walking was very disagreeable, but the slope was very steep and riding on our tired beasts very slow, so we walked most of the way and dragged our mules after us. Reaching Howardville, Mr. Wilson found that the expected supplies had not arrived, so he concluded to finish the piece of country east of Howardville and down the Rio Grande as far as might be convenient. The next day, August 18, we started eastward up Cunningham Gulch, up which a well-marked trail leads over to the Rio Grande. This is by far the most interesting of the secondary cañons of the Animas system. After passing the main bend, which is about two miles east of Howardville, the side-slopes become steeper and steeper, and finally end altogether in becoming nearly vertical bluffs. These are nearly, if not quite, as high as those along the upper course of the Ani-

mas, already described. On the west side, these bluffs are rather more precipitous than on the east, and come down closer to the stream-bed. These consist usually of a series of bluffs one above the other, receding from the view. Over the last tier, which is from 1,000 to 2,000 feet above the stream, numerous small streams of water pour, and passing over the succeeding bluffs in falls and cascades present a beautiful spectacle. In the early spring, when the snow is melting and they are swollen to considerable streams, the sight must be magnificent. A number of mines are located high up the slopes wherever they are not too steep to be ascended. Here and there a little low hut is visible on the east slope. Near the head of the gulch the trail is very muddy and badly cut up by travel. The upper part of the cañon ends abruptly with steep, high bluffs on all sides, except the narrow strip up which the trail winds to the pass. Several lodes are located at the head of the gulch. The amphitheatrical form of the head of the cañon with the great bluffs are very characteristic of volcanic formations, and all over the San Juan region they are the rule rather than the exception. Nevertheless, the sudden termination here of the great Cunningham Gulch is exceedingly interesting. The stream falling over these bluffs serves to heighten the effect.

The trail now leaves the creek and ascends the east slope. It is very steep and always muddy and slippery. The grade may be appreciated by calling to mind the fact that from the bed of the stream to the pass the rise is about 1,500 feet in one and a half miles horizontal.

The incessant travel over this trail by the miners, with their horses, mules, and burros, keeps it in a bad condition. Although it can scarcely be said to be dangerous, still its slipperiness adds much to the labor of the already overwrought beasts of the miners. The really bad part of the trail is only a small part of the whole distance. On the summit the ground is gently rolling, and the trail passes between low hills which form the principal part of the country in the immediate vicinity. The elevation of the pass above the sea, as determined by a single reading of the mercurial barometer, is 12,090 feet.

We made station 17 on a table a short distance southwest of the pass. From this vicinity a good view of a number of the most rugged of the quartzite peaks may be had. Those that appear range in height from 13,600 to 13,800 feet. After camping overnight on the head of the Rio Grande, the next day we made station 18 on a peak between Pole and Lost Trail Creeks, whose elevation is 13,656 feet. From this peak we had a good view of the country south of Lake Fork. In this vicinity are scattered a number of pretty high peaks, but they are generally isolated from each other, and have none of the massiveness of the mountains about the head of Lake Fork and the Animas. In ruggedness they cannot compare with many that will be described further on. To the east the slopes begin to be more gentle, and at a distance of a few miles appears a pretty extensive plateau surrounded by high bluffs. The next day, in passing down the Rio Grande, we noticed a very peculiar formation consisting of a very bright-green-colored rock weathered into little needles and spires. It is situated against the south side of station 18. After camping near the junction of Lost Trail Creek with the Rio Grande, we made two stations on the high plateau, just to the east of the camp. The climb was very difficult on account of the great masses of fallen timber we encountered and the bluffs that came in our way. Once on the top of the plateau, the riding was very easy. It was covered with loose rock, (trachyte,) but not so much so as to seriously impede our course. There being no prominent point, we were compelled

to make two stations. No. 19 was made on the eastern part of the north edge, No. 20 on the west. This plateau may be said to cover about five square miles; the elevation of most of this is over 12,000 feet. The eastern part slopes off quite gradually, while on the northwest and south the plateau terminates in bluffs which in many places are several hundred feet in nearly vertical height. To the east of this the ground becomes more and more even, till at a distance of about fifteen miles down the river Bristol Head rises abruptly to an elevation of 12,800 feet. From this position it appears in profile. A series of high plateaus extend southward from station 2, all above timber-line, and ranging in height from about 11,500 at the lowest point, a few miles north of Bristol Head, to about 13,000 feet, near station 2. Southward from the lowest point, the plateau slowly rises till, after culminating in the bald summit of Bristol Head, they fall suddenly 4,000 feet down to the Rio Grande, and so terminate. From station 19, a grassy slope, which we afterward found to be Antelope Park, seemed to extend to the bluffs of Bristol Head, but after looking with the field-glasses we saw that a cañon intervened. But look at it as much as we would, there was a peculiar appearance about it we could not then explain. From station 20 we had a splendid view of the Rio Grande Pyramid, which was eight miles distant, and across the river from us. This is probably the finest view that can be had of this beautiful mountain. Its pyramidal form is almost perfect, while at the same time there is just enough bluff intermingled with the *débris* slopes to give relief without the usual accompaniment of coarseness.

We left the plateau quite early, as we had a long distance to travel before reaching camp. The pack-train, according to orders, had traveled up the creek which comes into the Rio Grande from the south, a little below the mouth of Pole Creek. We proceeded without delay to follow them. At first the riding was quite easy. We passed several salt-licks, which were tramped full of tracks of deer and mountain-sheep. Soon the cañon narrowed in and traveling became very difficult. We found no trails, tracks, or signs of any kind to indicate that anybody had ever gone up the creek before us. At several points the going was very dangerous; at one place that I now recall to mind it was especially so. The creek at that time was a considerable stream, and, from the great fall it had, was a perfect torrent. The bed was filled with large stones, and between these the water boiled and foamed terribly. At this point we had to slide our mules down a very steep, rocky slope of about a hundred feet in height; at the bottom there was scarcely room enough for a man to stand conveniently between the slide and the stream. Just above this point was one of those deep pools where the big trout love to dwell, while at its lower end the water rushed through between several large rocks like a mill-race. Now the only way to cross was just at the lower end of the pool, where the water was shallow; below, the current was dangerously swift; above, the water was 6 or 7 feet deep. Leaving the mules and instruments with me, Wilson scrambled across to the other side, and I threw him his mule's rope, and while he hauled I whipped the beast behind. After a few minutes of this treatment, with the asinine obstinacy for which this particular mule was famous, she leapt out into the pool and, swimming up to the head, tried to climb up a smooth, wet rock, but did not succeed. After a thorough stoning she finally returned to me, and we repeated the experiment, this time with better success. Next, my mule, "Bones," was taken in hand. Having passed through the valley of humiliation the year before, and probably having taken mental notes on the disgraceful failure of her

comrade's first attempt, she "made the riffle" with little trouble. Other experiences of a little less exciting nature served to heighten our disgust for this creek. Having climbed over 2,000 feet in the morning, and made two stations, we felt very tired, and our mules walked slowly on. After a while darkness began to come on, and camp did not appear. "Bones" began to take on that pitiful look engendered by her horror of having to stay out. Every time that such a contingency seemed probable her lower lip would fall and hang down in a strangely sorrowful way. She seemed to recall that awful night in the Greenhorn Mountains, in 1873, when she slept out away from her companions, and where, after several months of unceasing labor, that one night broke her down and made her lip hang down as it never hung before and never did again. Soon, however, we came again upon the tracks of the train, and her long ears pricked up and she became so excited over it that I could scarcely keep her in a walk. When the camp-fire appeared and she got the scent of her companions, she seemed perfectly happy and contented, as we were also. For some distance below camp the stream-bed had widened out into quite a little valley, which continued above camp up to the head of the stream.

The next day, August 22, we made the ascent of the Rio Grande Pyramid. The day was beautiful to its close, a remarkable circumstance for this season of the year in these mountains. As we were camped at the foot of the mountain we had plenty of time. Wishing to give the mules a little rest, Mr. Wilson directed Ford, one of the packers, to follow after and bring them back to camp. We rode up the west slope of the mountain to near 13,000 feet elevation. Taking off our instruments, we threw the stirrups over the saddles, and fixed the bridles and ropes so that they could not get caught in the timber. We then tried to start the mules back to camp by throwing stones at them. They would move off a little, but if we tried to drive them farther they would dodge back. The reason seemed to be that they had noticed that camp always was made in a different place each day, and they were afraid of getting lost if they strayed off. Their great horror of getting lost was very noticeable in many cases. In every case where we had to hunt for the camp after dark, they seemed to give up entirely and put their whole trust in their riders. Often have we left them loose, at elevations ranging from 12,000 to 13,000 feet, far above the timber-line, but they never attempted to stray away, although they would crop whatever grass they could find near. At times when they could not be tied so as to get enough grass, we would take off saddle and bridle, and leave them perfectly loose, but it seemed to make no difference.

The climb on foot was quite easy, and did not amount to more than about one thousand feet vertical. On the top we found a nicely-built monument of stones, which we increased in height to about 6 feet. Some enterprising climber seems to have taken a just pride in leaving his mark on this beautiful peak. The fact that the monument was on the true summit indicated the fact that its builder was something else than a common miner. The height of this peak (station 21) is 13,773 feet above the sea. The view from here is very fine. The whole mass of the quartzite peaks, so often mentioned as prominent features in the views from previous stations, from here stand out clearer than from any point yet visited. Almost all of the higher points are clearly visible, but they are massed together in such a way that from this point the drainage of the system cannot be made out at all. In one place, to the south of us, we could see low rolling country, indicating that we were near the southern termination of the high mountains. To the

east the view was very extensive, many points of the Sangre de Cristo range, east of San Luis Valley, being clearly visible at a distance of one hundred and ten miles. In the descent nothing of special interest transpired. The next day camp was moved up to near the timber-line, at the head of the creek, while the three of us followed up a branch coming in on the east side, and, crossing the national divide, made station 22, on the southern point of a granite ridge, at an elevation of about 13,000 feet. The divide here is very near the boundary between the trachyte and quartzite. This line marks a sudden and decided change in the nature of the topography. Station 22 is on granite, the first we had yet come across in the district, but it only appears here in a small area. Before leaving we were again visited by an electric hail and rain storm, which soon cut short all work. Although surrounded by high peaks, rising several hundred feet above us, the phenomena seemed quite as marked as at any previous time. The whole mass of peaks west of us was soon veiled in clouds. Just as we were leaving the little knob on the end of the ridge which had formed our station, we all felt a heavy shock as if from an electric battery. Being unaccompanied by thunder, we concluded that we had been subjected to a miniature stroke of lightning. This is the last station where we felt any electricity, although we were often caught on the peaks in rain and hail storms. The next day we had a storm almost exactly similar to this one, only it was entirely unaccompanied by electricity. The date of this station (station 22) was August 23. The rain continued falling during our ride to camp, which we found located in a clump of pines, at the junction of two small streams. Like all the trees near the timber-line, these had few branches, and furnished us little protection from storms.

Next morning the sky was pretty clear, so, leaving camp remain where it was, we crossed the divide south of us, and ascended the high quartzite mountain east of the Vallecito. This quartzite rock is very hard, and breaks off in angular fragments with almost polished faces. Where *débris* slides are formed of these fragments it is found that the rocks slip and slide on each other very easily. Sometimes we would step on a stone weighing several tons; it would tip up, as if delicately balanced, or slip from under us. These seem to be universal characteristics of quartzite *débris*, so that in climbing over it great care is required. This peak was very steep and difficult to climb; in fact, more so than any we had yet ascended. When we had nearly reached the summit, and at an elevation of 13,600 feet, a small grizzly bear suddenly jumped up a few yards in front of us and rushed down the steep slide on the south face of the peak. Of course, in a climb as long and difficult as this, our instruments and books were all we cared about bringing with us, and for this reason our guns were left behind. We were much surprised to see an animal in this place. It is ever thus; when you feel you are treading a path never trod by a living thing before, and your imagination begins to build for itself a romantic picture, if some such vile, worldly thing as a paper collar or a whisky-bottle does not intrude itself on the sight, some beastly quadruped needs must break the precious solitude and scatter your airy castle to the winds. To show our utter disgust for all animate things that could not live below this altitude, we yelled and threw stones after the bear till he finally was lost to sight far down the mountain-side. In our hate we even wished he might have been in a position whence we could have rolled rocks down on him. As we passed on we saw several places where he or others of his breed had scraped out beds among the finer *débris*. They seemed to have come up here for fresh

air, or to sun themselves, or both. After this experience we named the peak Mount Oso, from the Spanish word for *bear*. As we neared the top of the peak the clouds coming from the west began to touch the summit, and we expected that the electricity would prevent any work. As we came up into the cloud we felt no electricity, at which we were much surprised. Setting up the instrument, we worked for about an hour, getting sights through the clouds, for as yet the storm had not fully commenced. The height of this point is 13,640 feet.

A number of sharp, distinct peaks, all quartzite, rise up in this vicinity from 2,000 to 4,000 feet above their bases, and all very steep and rugged, more like needles than mountains. A number of little lakes are dotted here and there at the heads of the cañons. To the west, across the Vallecito, the view into the high quartzites was much obstructed by clouds. To the northwest, at a distance of about six miles, in the center of the group, was a high peak, having its strata vertical, and all the upper portion formed of great vertical pillars of quartzite. It seemed to be on the center of upheaval, as on the two sides of it the strata inclined in different directions. Its elevation is about 13,783 feet.

In the immediate vicinity of our station the strata dipped at every possible angle, and appeared so complicated that only a very detailed study could ever bring order out of the chaos.

In our descent from the peak we got pretty thoroughly drenched, and found our mules looking disconsolate. We had left them near the second little lake northeast of Mount Oso.

Crossing the pass near this lake, we passed over to our camp on Rio Grande waters, encountering much miry ground on the way. The rain continued falling steadily all day and all night. The next morning the creek near our camp was flooded, as were also our little tents. Rain continued next morning, and as the elevation of this camp was 11,600 feet, and the timber thin and scattering, it was a poor place to remain during a storm. Hoping that it would clear off, we did not start early the next morning, but seeing no prospect of a change in the weather, we saddled up early in the forenoon and departed for other scenes. Our supply of provisions was getting very short, and we could not remain longer any way. All our flour had already given out, while the dried apples, beans, and even the bacon were beginning to draw to their close. With all these solemn facts staring us in the face, the caravan started about 10 o'clock a. m. Our course lay up the creek and over the pass we had crossed the day previous. We found the whole country flooded. Naturally very boggy, the ground was now so full of water that it almost floated.

The next morning the rain still continued. As the supplies were getting short so fast, we concluded to strike the nearest way for Howardville. Moreover, we were getting disgusted with this part of the country, and wanted to find a better camping-ground. Accordingly, we moved up the main branch of the Vallecito. It was running considerable risk, as without a trail to guide us we felt doubtful about being able to cross the divide. The rain fell fast, and we were soon soaked to the skin. The grade being very great, we rose in elevation very fast, and soon found snow and rain falling together, and we nearly froze. We stopped at one place and made a fire to warm our feet by, but the wood was so soaked with water that we found it a difficult task. The train was behind and did not catch up; so Wilson and I heaped all the logs that were lying handy upon the fire, and, as we found later, the rest of the party made good use of the fire. Near the head of the creek the slope became very steep and rose up to the divide, which, at the point we

crossed it, was nearly 13,000 feet in elevation. A keen, strong breeze did not serve to add to our comfort in our present saturated condition. While waiting here for the train, Mr. Wilson made station 24 on a point east of the point where we crossed the ridge. The elevation of this place is about 12,700 feet—a little higher than the point where we crossed the same divide a few days ago. We traveled down that branch of the Rio Grande which heads between stations 24 and 25, and camped in a splendid grove of pines. In the afternoon the sky had begun to lighten up. Isolated clouds passed swiftly over us from the west, ever and anon cutting off the sunlight, and producing the sudden chilling effect always noticeable in the shadow of a cloud at high altitudes. The great difference of temperature in the sun and in the shade at these altitudes is very remarkable. At this particular time I thought I noticed that whirls and gusts of wind always accompanied the fast-moving shadow. Whenever a long space between clouds allowed the sun to shine unobstructed, for some time the air would be quite still, but the next cloud-shadow seemed to bring with it little whirlwinds and changing gusts of chilly air. By the time we had unsaddled our animals the sun was shining brightly, and now, after three days and nights of incessant rain, we had a good opportunity to dry our clothes and blankets, and every one made good use of the short time before sunset. In the evening, instead of sitting down to a hearty meal, we had to make our supper on bacon and dried apples alone, and very short rations at that. We had a few beans left, but all the bacon and apples were used up for supper; but as we expected to reach Howardville the next day, we did not mind it so very much. Our bill of fare next morning presented only two articles, beans, which on account of our elevation could not be well cooked, and sugar. We could take either or both as we chose. Beans with other food are very strengthening, but alone we could scarcely eat them at all. The pack-train started direct to Howardville, while Wilson and I climbed the most northern of the quartzite peaks, a point having an elevation of 13,576 feet above the sea. The day was clear, still, and beautiful. After riding as far as we could, we still had about a thousand feet to climb on foot over the steep *débris* slides before reaching the top. We soon discovered that our breakfast of beans and sugar formed a poor foundation for such hard work. Once on top, a row of ten distinct peaks stretched in a nearly east and west line before our eyes. Their ruggedness may be understood from the illustration of "the Quartzite Peaks from station 38," the three or four on the left of the picture being just in front of us from station 25. Being much nearer, they appeared much more rugged than from station 38. The peaks in this row range from 13,560 to 13,831 feet in elevation. Between them we could see the higher peaks to the south.

The great and essential differences in the topography resulting from the change in the geological formation is here so very marked and is so interesting that I cannot pass it by without notice. The general difference in the appearance of the country in trachyte and quartzite formations is intended to be shown by the two large topographical sketches presented in this report. The view of Mount Sneffels from station 29 shows nothing but trachyte rock, while the sketch from station 38 shows quartzite only. But a mere sketch cannot show well the characteristics of the two. I have tried to work out some of the features peculiar to the topography of each of these two formations. These being derived almost wholly from observations in Southern Colorado and for the great part in this particular region, they may not have a very general application.

First, then, in trachyte or volcanic rocks, the lava-flows being for the most part horizontal, the rock fractures vertically, and the falling away of pieces produces bluffs which are generally very nearly vertical. Moreover, from the nature of the flow, horizontal lines or bands are left running across the faces of all the bluffs. This latter is very characteristic of the formation.

Second. At the bases of the bluffs *débris* slopes commence, and sweep down generally in graceful curves to a greater or less distance.

Third. These slopes are seldom very steep for any great distance; the great fall from the mountain-summits to the valleys being by way of high bluffs and comparatively gentle *débris* slopes. In other words, the total fall is very irregularly distributed over the distance from the top to the base of the mountain.

Fourth. The junction-line of the bluffs and *débris* slopes is almost always distinctly marked.

On the other hand, in quarzite formations—

First. Bluffs vertical, or nearly so, are very common; except in very rare cases, there are no marked horizontal lines.

Second. The junction between the bluffs and *débris* slopes are never so distinctly marked as in trachyte.

Third. On account of the fact that this rock breaks off in large angular fragments, and also on account of its great hardness, it will lie at a much steeper slope than the other rock. From the same causes the loose rock does not take on those beautiful sweeping curves so common in volcanic rocks, but have a certain stiffness of line.

Fourth. The solid rock, from its great hardness and the manner of its crystallization, is often found in very steep, yet quite regular slopes, without taking on the form of bluff. A noticeable instance of this is the most easterly of the ten peaks mentioned above. The fall from its summit to Vallecito Creek on the east is 3,000 feet, in less than a mile horizontal, or a mean slope of nearly 32°; yet it is a plain slope of solid rock, more or less irregular of course, but having no bluff in all that distance. On the north side of the same peak there is a slope of somewhere between 60° and 80° for not less than 2,000 feet, yet there is no part of it bluff.

Still another point is the fact that in the metamorphism of the original sedimentary rocks into quartzite, the great natural convulsions attending that process have distorted the strata terribly, so that, as in this particular region, a number of peaks in a small area may each have its strata dipping at a different angle from all the rest. The effect of this on topography may be seen in the sketch from station 38. The high peak next to the last one on the left shows in a marked manne that the strata inclines to the right or southward. The high peak ne the middle of the sketch, being in the center of upheaval, has its strat vertical, while those farther to the right incline to the north. Thi latter fact is not so well shown in this sketch, but from some oth points of view it appears very plainly. These facts show how the for of the peaks may vary in the same kind of rocks; but, as there is little c none of this upsetting of the lava-flows, there must result a distin type of mountain-form for each. The peculiar crystallization of the quartzite has also a marked effect on the forms.

In accordance with these facts, we find that quartzite mountains are generally much more rugged, but lacking the relief given to those in volcanic regions by the contrast of the bluffs with the *débris*-slopes. The boundary of the quartzite on the north follows closely the national divide.

View of Mt Sneffels looking North West from Station 29.

On our return to Howardville we rode across the rolling ground which extends southward from Cunningham Pass. Arriving at the town, we found Mr. Jackson, the photographer of the expedition, with his party. He had just arrived from the Los Pinos agency. We made the ascent of Sultan Mountain in company, and Mr. Jackson succeeded in getting a number of good photographs of the surrounding country. From here is obtained by far the best view of Baker's Park that is obtainable from any peak in the vicinity.

After getting our supplies we marched up Mineral Creek, while Mr. Jackson struck south over the trail which passes around the west side of Sultan Mountain, and made a very interesting investigation of the old ruins in Southwestern Colorado.

In the afternoon rain fell, and continued into the night, but the next morning was cold and the sky clear and beautiful. This date (September 3) is remarkable as being the time of the abrupt change between summer and fall. After this, till the snow-storms commenced, the weather was cold and clear. Having camped overnight at the junction of Bear and Mineral Creeks, the next morning we moved up the latter, and made stations 27 and 28 on a high ridge between Mineral and Cement Creeks. Camping near the head of the creek, the following day we crossed the pass at its head and passed over to the head of the Uncompahgre River. The elevation of this pass is 11,100 feet above the sea. It is entirely covered with timber. The slope to the south is quite gradual, but to the north, down the Uncompahgre, the fall is 800 feet in two miles. Then for several miles the stream flows comparatively smoothly, till it finally enters a deep box-cañon, where the fall is very great. Traveling for some distance is both difficult and dangerous. At the bottom of the first steep slope a great area of fallen timber commences. The logs so cover the ground that traveling is very nearly impossible. Leaving a notice for the pack-train to camp near the beginning of this dead timber, Mr. Wilson, Dr. Endlich, and I rode on, and finally got through the timber, when we had open grassy ground to travel over, but the slope was so steep that we could ride only a small part of the way. Leaving our mules loose, as usual, to find what grass they might at this elevation, which was a little under 13,000 feet, we made station 29, on a round-topped peak, which, being surrounded by peaks higher than itself, is of no great importance. It was taken as a station, because its position between two of the main branches of the Uncompahgre made it a key-point for the drainage-system which forms the head of that stream. Its elevation is 13,206 feet. From here we got by far the best view of Mount Sneffels, and the curious pinnacle-forms in its vicinity, which have already been mentioned as seen from station 10. The accompanying illustration, taken from a hasty topographical sketch, will give a faint idea of the great peak and its vicinity. Of course the elevation and ruggedness of the mountains shown in the sketch can only be appreciated by a person who has climbed many mountains. Even then the air is so clear at these high altitudes that one is deceived in spite of himself with regard to distances. From here we could see no feasible route by which to climb the great Mount Sneffels, so we laid the question aside till a view from some peak further to the west should solve it satisfactorily. Next day we retraced our steps over the pass and down Mineral Creek, camping again at its junction with Bear Creek. Moving up the latter stream, we camped on a considerable branch which comes in from the north. This is probably the finest camping-ground on the whole stream, with fine timber, good water, and a sufficient quantity of grass. Above this

there is a dense grove of timber, through which you pass up a pretty steep slope; in a short distance the pines end, and you come out into an open space, extending several miles up the stream, and covered with a remarkably rich growth of weeds and shrubs. This circumstance is probably explained by the fact that here a great part of the lower slopes of the cañon is composed of red sandstone, which seems to produce a much better soil than the volcanic rock.

The next day (September 6) we made the ascent of the highest peak in this vicinity. It is marked station 30 on the map, and has an elevation of 13,897 feet. The climb was difficult, on account of the long slopes of loose *débris* up which we had to climb. The top of the peak was remarkable for its smallness. It is formed of two knobs, about 20 feet apart, the northern one being a little the higher, and connected with the other by a very sharp ridge. To the west was a slope of 60° or 70° for 30 to 40 feet, then a precipice of about a thousand feet nearly, if not quite, vertical. When the tripod was set up, we could not pass around it, but, if it was absolutely necessary, had to crawl under the legs of the tripod. The three monopolized all the sitting and standing room on the peak. Mr. Wilson with the instrument completely covered the true summit. Dr. Endlich took his geological notes from the lower knob, while I sketched, sitting at the edge of and almost under the instrument. The slopes on all sides, but the narrow path we came up, were very steep, and in a few feet terminated in great precipices. From here we got a splendid view of Mount Wilson, which we had seen from many stations before this, but always across the group of mountains of which station 30 formed a part. Now it rose up grandly, forming the most massive of any peaks in our district, and, judging from its appearance and rough estimates from the angles of elevation, we felt that it must be very high. In line with the peak, but several miles nearer, appeared Lizard's Head, a peculiar pinnacle, which from this view appears quite broad. It will be more particularly noticed further on.

After finishing our observations, we built up a small monument of loose stones, which, when finished, covered the top so completely, that a person could not pass around it. We descended much easier than we had ascended, and found camp, at the lower end of a long patch of timber, near the junction of the main stream with its last tributary which comes in from the south as you travel up. This marks the upper end of the open, weedy area already mentioned. The total climb from our last night's camp to the station was 4,000 feet, and the descent to our present camp 3,200 feet. On the day following we let camp remain where it was, and rode up the creek to the south of us, and over the divide, to Engineer Mountain. On the way we had to pass around a peculiar amphitheater, which had been eroded out of the red sandstone. The stratification of the sandstone produced benches, which extended all the way around the head of a little stream which flows into Cascade Creek. We found the ascent of the peak not very tiresome, but rather dangerous. We climbed up the ridge from the east. On our right was the great bluff, which is nearly a thousand feet in height and almost vertical. On the southeast side the rock weathered off in small plate-like fragments, producing innumerable cracks and little shelves, but none large enough to give a secure foot-hold. The slope on this side is very steep, so that if a person should once slip he could not possibly save himself from destruction. Mr. Prout in 1873 ascended this same peak from the south side, which I should judge is much the safer, but at the same time the longer and more tiresome way. From this point we had a splendid view down the Animas. Animas Park was visible, and

the low country in its vicinity showed us that the high mountains were nearly at an end. A group of pretty high peaks were to be seen to the southwest, called the La Plata Mountains. They are completely isolated from the main mass of the range by many miles of comparatively low land.

On our return to camp a sudden and heavy shower of rain came up, but cleared off soon after. The next day found us on our way through the patch of timber already mentioned. The trail passes through the center of the group, which is very swampy, and our animals mired many times before we got through. We only found relief at the timber-line, after which we rode on, over grass and fine rock-slopes, up to the pass, which has an elevation, according to our aneroid barometers, of 12,600 feet. It is certainly the highest of all the passes leading out of Baker's Park. A pass which I think will be found much better crosses the range about six miles to the northeast of this. To go this way you must travel up the largest tributary of Mineral Creek, which comes in from the west, and cross over on to a tributary of the San Miguel. This pass is not less than a thousand feet lower, and, at least to the west, has a much better grade. Passing over from Bear Creek to the head of the San Miguel, after a sudden descent of several hundred feet, we came to a small lake. Further down, the slope was more gradual for some distance, till we came to a steep *débris*-slide, down which the trail led to the valley below. The fall from the pass to the valley, by way of the trail, is 2,800 feet in two miles. On the east side of the pass the rise from the stream-junction, where we camped, to the pass is 2,000 feet in two miles.

Station 30 rose up boldly just to the north of us as we rode down the trail. Its side was worn out into beautiful forms, and the delicate blending of the dull red and yellow colors of the rocks, taken together with the long sweeps of the *débris*-slides, gave this peak a finer appearance than any we had yet seen. Once down in the little valley below, we found the trees and grass growing very luxuriantly.

The trail crosses several boggy places, over which our mules passed with difficulty. A few miles down stream from the head of the little valley is San Miguel Lake, a very beautiful sheet of water, filled with fine trout. We stopped to make a compass station on the edge of the lake, and took a reading with the mercurial barometer, which makes the elevation 9,720 feet. Thence we traveled down the San Miguel River, along a very old disused Indian trail; in some places, considerable trees lying across it showed that it had not been used for many years. For some distance below the lake the San Miguel, which is here a pretty large creek, flows quite gently; but further down the slope suddenly increases, and the stream is broken up into falls and cascades. In going down the trail, at this point, we found the slope so steep, that we had to dismount and lead our mules, till we reached the bed of a large creek which comes into the San Miguel from the east. After crossing this the trail ascends the north slope of the cañon, which is quite steep. The total fall, from the lake down to the junction of this creek with the main stream, is about 900 or 1,000 feet in a distance of two and a half miles. At least 600 feet of this fall takes place in the last mile. At the bottom is a fine fall, which from a distance we judged to be not less than a hundred feet in height. After crossing the cañon of the creek above mentioned we came out on a pretty smooth area, covered with scattering timber and fine grass. One thing very peculiar about this particular part of the country is the deathlike stillness that almost oppresses one in passing through it.

There is the finest growth of grass I have ever seen in Colorado, with beautiful little groves of pine and quaking-asp scattered about, which one would expect to be full of game. The old trail and the very antiquated appearance of the carvings on the trees, and the absence of all tracks, old or new, indicated that the Indians had abandoned this route long since. With all these conditions, so favorable to animal life, we did not hear a bird twitter in the thickets, and saw neither deer, elk, nor antelope, nor even a single track of one of those animals. In all other parts of the country little squirrels and chipmunks were seen in abundance; but here, if they existed at all, they kept themselves close. We made camp on the large east fork of the San Miguel, just across the stream from station 32 on the map. The next day, September 9, we made station 32, on a low hill on the north side of the creek, which from its width might more properly be called a river. Above this for several miles the stream-bed is very flat and covered with willows, while the stream itself winds like a great snake. A short distance below our station the stream plunges down very abruptly into the cañon of the San Miguel, which, above and below this junction, cuts down from 800 to 1,000 feet into the sandstone which here makes its appearance.

Leaving station 32 on our way to Mount Sneffels, we followed the trail a short distance, and then, turning off to the right, with great difficulty succeeded in descending to the bed of a creek flowing from the northeast. In this vicinity we saw a band of six gray wolves, the first we had seen during the season.

With great difficulty we followed up the cañon, which gradually became narrower and more rocky. In some places we had to cross over short spaces of smooth, almost polished rock-surfaces, inclined toward the stream. In one such place a small rivulet of water flowed over the surface and terminated below in a fall of considerable height. The smooth stone, thus wet, rendered our passage with the mule-train very hazardous, as the least slip would have resulted in the certain destruction of an animal, and possibly serious injury to members of the party. As we traveled upward the trees became more and more scattering, and the huge rock-slides, which below we had only seen high up against the mountain-sides, began to extend their fingers, like glaciers, far below the timber-line, and in many places reached the bed of the creek. These slides, ever and anon crossing our path, rendered travel very difficult for animals; the more so as they were composed of large angular fragments, often many tons in weight, and containing in their interstices no vestige of soil or vegetation, Sometimes we were able, by filling in the spaces with small stones, to form a rough trail over these. At others, we were able to go around them.

The obstacles to our onward march continued to grow greater and greater till we came to the upper verge of a clump of trees, and found our further progress completely barred by the great *débris* slides on both sides of the creek, coming down to the water's edge, making the passage for animals an utter impossibility. About half a mile farther on we could see the trees commence again; but this strait, if we may call it such, was too much for us. Besides, we could see no prospect of good grass for the animals ahead, while this last group of trees formed a beautiful camping ground, and was overgrown with a rich crop of grass. There, then, we struck camp; and as it was early in the afternoon, and the sun shining brightly, we took this rare oportunity of spreading out our blankets to dry. Wilson turned out his mule with the rest to feed, and walked on over the rock-slides, up the cañon, to reconnoiter, and after a long and tiresome walk reached the summit of the pass at

the head of the gulch, and saw, far across, a curious sink-like amphitheater, the object of our journey, looming up in terrible blackness before him. He saw at a glance that from our present position the peak must be ascended in one day, from our present camp, all on foot. The mountain had to be climbed, and the only easier ascent was from the north. But to get to that side of the mountain necessitated a circuitous journey of several days around the portion of the mountains jutting out to the west.

On his return to camp in the evening he reported the result of his deliberations to the rest of the party, and it was concluded to make the ascent from our present camp. We all knew well that the winter-storms would soon commence, and we could ill afford to lose the time necessary to go around to the north side of the mountain. The present camp is marked on the map as camp 45.

ASCENT OF MOUNT SNEFFELS.

The next morning we provided ourselves with lunches, as was our custom, and the three of us set out on foot at six o'clock, with our note-books and instruments. The first portion of the climb to the pass above mentioned was in a northeasterly direction from camp. After crossing the portion of *débris* already described we came again to timber, then to soil covered with very short grass but devoid of other vegetation. After leaving the timber we could see about us, and a dreary sight we saw. Near us was nothing but these great angular fragments of trachytic rock, which, in the distance, faded to a dull, dreary, gray tint. In some places these slides formed long, regular, slightly-curved lines; in others the stone appeared in swells like sand-dunes. The head of the cañon was amphitheatrical in form, like almost all in lava regions. On the east side we noticed particularly a subamphitheater, which, being composed of nothing but the loose *débris*, variegated by neither shrub nor blade of grass nor even barren soil, nor by any change of color in the rock, presented one of the most desolate sights that meets the eye of the mountain-climber. The weird stillness of high altitudes only served to heighten the appearance of desolation about us, and gave one the idea that all nature was dead. Passing from the small area of soil over which we traveled after leaving the timber, we came again to the loose *débris*. Take note of that little patch of soil, for we may not step on soil again till we return at night from our tiresome climb. We now had to walk over the loose bowlders, stepping from stone to stone. This was very tiresome, as we could not relax our attention for a single moment for fear we should step on a balanced stone, and fall or slip on some smooth surface. Toward the last, the ascent became very steep, and we had to climb with great care. The last few hundred feet was just about as steep as loose rock would lie. We thought nothing of this, however, as we were fresh, and knew, besides, that this was the easiest part of our day's journey. We reached the pass at last, and as we had been climbing till then in the shadow we were glad to see the sun rising clear and beautiful. Everything seemed to conspire to make a beautiful day, and we lacked only time to let our imaginations run on and make a sublimely-romantic picture of sunrise at a high elevation. The claw-marks on the rocks, on either side of the summit of the pass, showed that the grizzly had been before us. We gave up all hope of ever beating the bear climbing mountains. Several times before, when, after terribly difficult and dangerous climbs, we had secretly chuckled over our having outwitted

Bruin at last, some of the tribe had suddenly jumped up not far from us and taken to their heels over the loose rocks. Mountain-sheep we had beaten in fair competition, but the bear was "one too many for us."

After stopping a few moments to draw our breath, we had a little leisure to look around us. Looking back we could see the clump of trees, 3,000 feet below us, in which camp was situated; while in front of us, and behind us, and around us, appeared nothing but miles and miles of loose rock, with rocky peaks everywhere. Immediately in front of us was a curious depression, which, at its lowest point, was about 2,000 feet below us, although we were standing on the lowest point of the ridge surrounding it. It covered several square miles in area; it seemed to be completely closed up, as no outlet could be seen. It was apparently walled in on all sides. On our right a bluff ran clear around to the great mountain, and was very nearly vertical for full a thousand feet, at some points more. For three miles from this pass, along the ridge on the south side of the amphitheater, no point is less than 13,500 feet in elevation, while several peaks rise above 13,700, and one above 13,800 feet. Just to the south of Mount Sneffels was another comparatively low gap, which we felt was passable for good foot climbers. This and the pass on which we stood were the only visible outlets; excepting these two, which were only just passable to men on foot, we could see no break in the great Chinese wall around this little empire of desolation and deathlike stillness. We knew, of course, that there must be an outlet, and we knew where that outlet must be, but we saw none; we knew that the wall around the south side, from us to the great peak, was continuous, and we could see that there was no break in the north wall for a considerable distance. The only point we were not sure of was at the northeast corner of the basin, just west of the peak. We were certain the outlet must be there, merely because we knew it could be nowhere else; however interesting it might have been from a geological point of vie w,it made our hearts sink within us to look at it. In making the ascent of a mountain, there is nothing more painful than to find a deep gorge or sink crossing your path; you know that all the distance you go down must be climbed up again before you reach once more your present level. We did not remain on the pass long enough to think half that I have written, for it has always been a maxim with us that every minute saved in the morning brings us back to camp so much earlier in the evening, and we can never tell how long a climb is going to take us. We find sufficient time while climbing to observe the scenery around us in a very general way, but the romance of our work is not fully appreciated by us till we reach civilization, where we can find leisure to think over what we have seen; at the time no romance is visible.

Almost due east of us and across the sink, at a distance of three miles, was Mount Sneffels, the end and aim of all our labors. We traveled over the sunken area a considerable time, as it is several miles across. As we went on it became more and more evident that the "fallen-in" appearance of this depressed area was not mere appearance. Evidence presented itself on all sides to prove that this great area had actually sunk in one mass several hundred feet. After a time the descent became much steeper, and we were much surprised on looking back to see behind us a peak rising up to a considerable height. The truth was, that it was only a ridge the same height as the main part of the amphitheater, and only presented the appearance of a peak from below. Near this point we were joined by Ford, one of the packers, who had concluded that he wanted to climb a peak, too, but had chosen this one, the hardest climb of the season. The lowest point of the amphitheater was the head

of a cañon leading out to the north. In the bottom of this was a small lake with an elevation of nearly 12,000 feet. It was rather a pleasure than otherwise when we began to ascend again. Now we were sure that we had no more gorges or sinks to cross, but that, excepting the ups and downs common to all peaks, our way lay uniformly upward. A few hundred feet above the bottom of the sink we came upon a bench on which were two small lakes, while just beyond, the steep, rugged mountain rose up. The first half of the height was very steep, but neither so tiresome nor so dangerous as the last half. The first was a plain slope extending from the lakes to the ridge of which the peak formed the termination. After reaching this we had to follow the sharp ridge of the mountain, which for a considerable distance was notched out much like a comb. The crystallization was nearly vertical, and we could not follow along the highest line of the ridge, but had to go down the spaces between the teeth of the comb, then climb hand over hand up the steep bluff beyond, and so on till, within a few hundred feet of the top, the rock suddenly changed and was worn into more or less rounded slopes, all considerably polished, but beveled out in a curious manner, by the weather. These slight bevels were our only foot-holds, and, as the slope was quite steep in some places, we had to climb with care; but all our labor was soon rewarded by the glorious view which presented itself to us when we reached the top. On the west and north sides the peak was precipitous, while on the east it sloped down much more gradually. It was situated on the extreme north edge of the range, and fell in very steep slopes to the low valley of the Uncompahgre, to the north. On all sides but this we were surrounded by rugged peaks and impassable cañons. The great fact which was instantly impressed upon our minds was the great area of the surface above timber-line. In fact, toward the east, south, and west, with the exception of a clump here and there scattered at great intervals, no timber was visible. Leading from the southeast side of the peak was a cañon, which, for a considerable distance down, ran nearly due east, but continually veering more and more toward the north. For several miles down, the slopes to the bed were very gentle, and presented the appearance of a deep hollow rather than that of a gorge; but it became more and more rugged toward its mouth, till finally, within a few miles of that point, it was almost impassable, till at last it joined the truly great cañon of the Uncompahgre River. This latter cañon and its vicinity is one of the most curious places in the district. The ridges running down to it both from the east and west sides are curiously notched and cut into strange shapes. Numerous high, sharp pinnacles, clustering together here and there, appear like church-steeples, while in other places the weathering of bluffs has produced the appearance of niches with statuary. Across this space, and far above it, we saw Uncompahgre Peak, which showed us the familiar precipice on the north side, with the terraced slope on the south. Though presenting to our eyes the same profile as when we were approaching it from the east, we had lost much of our awe of the mountain from the fact that we had found so many that were harder to climb. We could see distinctly every station we had been on, so far, this summer, besides many of the year previous. The group of quartzite peaks stood up as boldly as ever about thirty miles to the southeast. In fact, I may state here that we have never yet seen the group from any station (and we have viewed it from all sides) without feeling both deep respect and awe for their terrible ruggedness. The fact already stated, that the storm-clouds seemed to hover about them before starting on their meandering ways, only served to add to our other feel-

ings one of uneasiness. It may be that the vivid recollection of a long and dreary storm encountered in that region, made it appear to us in an exaggerated form. A little nearer, and slightly to the left of them, we could plainly see and distinguish all the peaks surrounding Baker's Park and the great mining region. Still nearer, and seeming almost under us, was station 28, with its associates, in the little cluster of deep red-colored peaks along the water-shed, between Mineral Creek and the Uncompahgre. The view directly south of us presented the greatest mass of peaks to be seen in any direction. In that direction we look longitudinally along the range of peaks which forms the west line of the great mountain-mass, from which there is a very abrupt descent to the western plateau system. Chief among these stood station 30, which we had visited only a few days before, while about nine miles to the west of it was the high peak which we were soon to climb, but whose top was veiled in clouds, only the massive base and a few of the subordinate peaks being visible. West of it were several low, sharp peaks scattered here and there, but these soon tapered off into the plain, which extended to the horizon, only broken by the deep cañons which have been cut in the red sandstone by the streams. Directly to the west, in the far distance, was the group of the Sierra La Sal Mountains, and scattered about the horizon, south of them, we could see several very distant mountains, which were so far away that their blue color could scarcely be distinguished from that of the sky. Immediately to the north of us, and far below us, was the valley of the Uncompahgre, which, on both sides, seemed to have quite a gradual slope toward the stream. To us, viewing it from this great elevation, it presented the appearance of being covered with a rich growth of grass, though of this fact we could not be sure from so great a distance. The junction of the Uncompahgre with the Gunnison was distinctly marked by the vegetation along the banks of the two streams. We could see the course some distance below the junction, but it soon faded into the distance, and no one could say, from what he saw, what way the water had gone.

Beyond the Gunnison, on the north, there appeared a very elevated plateau, which, commencing near the mountain-peaks, presented a nearly horizontal profile for a considerable distance, and then, slowly increasing, its slope fell off almost insensibly to the west. Still farther around to the right, and about northeast of us, we could see most of the great peaks west of the Arkansas River. Many others appeared behind, but we did not trouble our minds about recognizing them, as all our time was necessary for the more immediate details of the topography around us. The great length of time required to ascend and descend again prevented us from remaining long. We had reached the top about noon, and found that we could not possibly remain over two hours and expect to get to camp; and since there was not a stick of timber on the way we dared not sleep out, even though the work on the peak had to be cut short. Our time being up, we raised a monument of loose stones about five feet high and started for camp.

The descent to the lakes was very easy and did not require much time, but, as we expected, the climb up to the pass again began to tell on us, and a weakness in our legs showed what a terrible strain on our systems the morning's climb had been. We finally reached the pass just in time to see the sun setting. Some may suppose that now we sat down and rested ourselves before making the last descent down to camp. But all frequenters of the high mountains are acquainted with the fact that there, darkness follows sunset very suddenly, with scarcely any twilight between. By calling to mind this fact and estimating the obstacles

between us and camp, we found that with our utmost endeavors we could not hope to get into camp till long after dark. On the other hand, we knew that we could not travel any considerable distance over the *débris* after dark, so we struck for the timber with all our speed. When darkness came on we found ourselves in a mixture of vegetation and loose rock, and had to pick our way with the utmost difficulty. Our long-continued exertions were at last crowned with success, and we had the pleasure of sitting down to a supper which tasted to us far better than the most costly meals of civilization, served up in the most expensive hotels. We reached camp at eight o'clock in the evening, having been fourteen hours from camp, twelve of which had been occupied in steady climbing, and two in work on the summit of the peak. During those twelve hours we had climbed up 7,000 feet, and down an equal distance, beside travelling a horizontal distance of six miles, the whole over loose rock.

The next day, which was September 11, we retraced our steps down the creek, and turning to the right followed up the west branch of the same stream. We made station 34 on a peak at the head of this creek, whose elevation is 12,997 feet. It is the most western of the great group of mountains of which Mount Sneffels is the highest point. From here Lizard's Head, east of Mount Wilson, stood up like a high monument on the top of a mountain-peak. From this view the width of the base bears about the same relation to the height as in the great artificial monuments. The height of the column is 290 feet, and the elevation of the summit above the sea 13,160 feet. From this point it is fourteen miles distant in a straight line, yet it loomed up finely. On our way to camp, which we found located at the junction of the two creeks, we saw a black bear, the first we had yet come across, but he disappeared so suddenly that it was impossible to get a shot.

We were well satisfied with having finished this part of the mountain country. Only one peak remained yet to be ascended of which we had anything to dread, and that was Mount Wilson. From various circumstances we had reason to believe that this was higher than any station we had yet made, and from its rugged appearance we dreaded its ascent not a little. We returned to Lake San Miguel by the same trail we had come. On our way we saw a few cranes, which, with their long legs and unearthly noises, only served to add to the funereal aspect of the scenery. At the lake Dr. Endlich and I stopped to make a detailed sketch of station 30. From here the peak, with the lake in the foreground, and the rich groups of pine and aspen, separated by spaces covered with a rank growth of grass for a middle distance, presented a beautiful appearance. Crossing over the divide between the San Miguel and Dolores, at an elevation of about 10,200 feet, we turned off to the right and camped on a stream which flows down from the southeast side of Mount Wilson. On the way Mr. Wilson succeeded in killing a fair-sized male grizzly with his Springfield needle-gun.

September 13 was devoted to climbing the great mountain. Riding to the timber-line, we sent our mules back to camp by one of the packers, and commenced the ascent. At first we had a low bluff of slate to get over. The plates of the stone were remarkable for their great size and freedom from cracks. Above this the climb was quite easy for a considerable distance, being nothing more than plain slopes of loose *débris*. When we had reached an elevation of about 13,000 feet, we noticed three mountain-sheep on the top of a high ridge to the north of us, and about 1,000 feet above us. We could scarcely see how they got up there, such was the ruggedness of the ridge. They watched our

progress from this elevated stand-point with great interest, now and then jumping upon a rock to get a better view. They reminded us very much of some of the illustrations in the school geographies. A little farther on we came to a large steep snow-bank, up which we climbed with difficulty, cutting notches in the snow for foot-holds. At the upper end of this we came to what was much worse, very steep and dangerous rock-walls. From this point to the summit the stone is crystallized into vertical blocks, broken up so as to be very insecure. Near the beginning of this part we came to a notch in the narrow ridge which was filled in by a great stone, with its upper part wedge-shaped. On the east was a fall, very nearly vertical, of two or three hundred feet, terminating below in the steep snow-bank already mentioned. On the west was a precipice many hundreds of feet in height. Over this wedge we had to pass by straddling it and sliding ourselves carefully across. The whole distance was not more than ten or fifteen feet. It seemed very much like crawling along the comb of the roof of a very high house. Just beyond arose a steep rock-wall of loose shelving rock, up which we climbed with great difficulty, from the fact that all the rocks were loose; and even the largest could not be surely depended on. Reaching the summit of this we had to walk for forty or fifty yards along the sharp ridge over loose blocks of stone standing on their ends. The ridge was so sharp that we had to follow the center. On either side the slopes were so nearly vertical that if a person should once slip there would be nothing to stop his descent for many hundred feet, and in some places a thousand feet or more. All the stones were so loose that we could feel them move under our feet. For a part of the distance we had to walk straight, without anything to lay our hands on. At one point in particular we had to leap across a break in the ridge where a stone had fallen out,trusting to Providence for the firmness of the new foot-hold. This was at an elevation of nearly 14,200 feet. We came very near giving up here; but we could just get a glimpse of the main peak a little farther on, and the temptation was too strong for us. After getting over this very dangerous part, we came to a deep crevasse which cut across the ridge, and succeeded, with great difficulty, in getting down to the bottom of it. A thin coating of ice over many of the stones, remaining from a recent hail-storm, added greatly to the danger of the climb. Thence we had to climb around the edge of a bluff, which we found a very dangerous undertaking. Once over this we climbed out of the crevasse without difficulty and gained the longed-for summit. We found it composed of the same rock as I have described, crystallized in vertical prisms, but crumbling away. Beyond a space probably eight or ten feet square, we could not pass without the very greatest danger of being precipitated over the terrible bluffs surrounding us on nearly all sides. We could scarcely find space enough for a monument, with room enough to pass around it. We did, however, leave a small monument of loose stones to mark this station, (station 35.) The thermometer stood at 33° Fahrenheit, which, with a steady breeze from the west, did not add to our comfort, especially as we had to confine our movements to such a small area. While we were up here clouds began to come from the northeast directly toward us and against the wind, apparently moved by an undercurrent, as they were below us. We could trace distinctly the track of the slight snow which fell the last night, by its marks on the peaks of the great mass. This peak was a splendid point for a station, giving the key to the drainage and topography for miles around. To the east and north the San Miguel and its tributaries appeared to us, from our

View of the Quarzite Peaks from Station 38 looking East across the Great Cañon of the Animas

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elevated stand-point, as if laid down on a map. Lizard's Head, a few miles east of us, formed a very prominent feature in the landscape, although, looking at it from our elevation, (14,280 feet,) its height did not show. From this direction it appears quite broad, from the fact that its greatest length is from north to south. To the west of us and quite near was a pretty high mountain. Beyond it were scattered a number of sharp, isolated peaks, mostly under 13,000 feet in elevation, while still farther to the west extensive plateaus reached to the horizon. In the far southwest appeared several very dim, bluish mountains, probably considerably over a hundred miles distant. Somewhat nearer to us, and a little farther around toward the south, appeared Ute Peak, near the southwest corner of Colorado. In the far northwest the Sierra La Sal Mountains were distinctly visible. Much was also seen that has been already described as having been seen from other stations. This is the highest mountain in Southern Colorado, and by far the most massive.

The descent was made with great care, and, luckily, without accident either to ourselves or the instruments. The descent over the snow-bank was much easier than the ascent, being accomplished by simply sitting down on the snow and letting gravity do the rest. Below it, we found several holes among the loose rocks, which bears had pawed out for beds, but we met none of the animals themselves. We reached camp quite early. The total height climbed on foot was 2,500 feet. It was not very tiresome, but by far the most dangerous of all the climbs of the summer.

After this we marched a short distance down the Dolores and made stations 36 and 37. After that, returning by way of San Miguel Lake, we recrossed the Bear Creek Pass, and camped at the creek junction, where we had camped a week previous. The day after, we rode to Howardville. We had scarcely got our dinner, when Mr. Jackson and party came up from their trip to the ruins, of which they gave glowing accounts. On September 19 we started down the Animas, crossing, over the southeast slope of Sultan Mountain, by the trail. We found the trail very bad. At one point a tree-stump projected into it. Some miners passing over this route a few days before had one of their animals killed by its falling down the side of the mountain at this point. The divide is about 10,460 feet in elevation, but the highest point of the trail is several hundred feet higher. We camped near this latter point; and the next day left the train to follow along the trail a few miles and camp, while we rode in a southeasterly direction and made station 38, on a rounded peak of quartzite, 13,046 feet in elevation. From here we obtained the most striking view of the quartzite mountains. The illustration is reproduced from a topographical sketch made at this station. The point is on the brink of the great Animas Cañon, which here is over 4,000 feet in depth; a few miles farther down it is still deeper. The total length of the Grand Cañon, from the mouth of Mineral Creek down to that of Cascade, is about seventeen miles; below this, for about seven miles, it becomes very narrow and straight, with a depth of about 1,000 feet. In returning to the trail we found the country terribly cut up along the head branches of Lime Creek, and even after reaching the trail it was not the easiest we had yet had. Judging from what I have heard and seen of the pass to the west of Sultan Mountain, I think it a much better route. Some fallen timber and swamp are encountered, but not more than on this trail. We did not travel over it ourselves; but Mr. Jackson, who has been over both, gives the trail over the western pass the preference. If ever a wagon-road can be built over into Baker's Park, from the south, it will only be by that way. The ground

is very rough along the trail to a mile or so south of the crossing of Cascade Creek, when it becomes more even, and the traveling from there on is very good. Wagons could be brought up this far, from the south, without the least trouble. A long line of sandstone bluffs extend parallel to the trail for several miles, and rise from 1,500 to 1,800 feet above it. The trail passes along a sort of table, with these bluffs rising above it on the west side, and the Animas Cañon bounding it on the east. Arriving at Animas City, we stabled our riding-mules in a deserted dwelling-house, and, hanging up our instruments in another, across the street from the first, made a thorough exploration of the city. We found it located on a beautiful level patch of ground, with scattering yellow pines growing all over it. It was composed of one street, with a row of log cabins on either side stretching a distance of several hundred yards. Some of the houses were nearly finished, some half done, and the sites of others were marked by two or three tiers of logs laid one above the other. All were deserted. We took possession of the best-looking one, which had a kitchen attached, and made ourselves very comfortable; eating inside and sleeping out of doors. The night was so bright and clear that we could not endure sleeping under a roof. We found several persons living in the vicinity, and from them we learned that the settlers had been time and again ordered away by the Indians, and finally considered it best to leave. The height of this place is 6,850 feet. From Baker's Park to this point, a distance of about twenty-six miles, the Animas has a fall of 2,550 feet, or an average of 100 feet to the mile. Trout are found in the river here, but how abundant I cannot say. They have never been caught as far up as Baker's Park—caused, probably, by falls between the two points.

Traveling down stream, the stream-bed soon widens out into a very pretty valley, bearing the name of Animas Park. It extends from a point near Animas City, so called, down the river about fourteen miles, with a maximum width of two miles. The total area may be estimated at twenty square miles, but the part capable of cultivation does not amount to more than three or four thousand acres. The greater portion of this can be irrigated at little expense. In passing through it we saw corn, wheat, potatoes, turnips, and water-melons growing finely, but all abandoned on account of Indian troubles. This valley is very interesting in many respects. First it contains almost the only tillable land within a hundred miles of the mines. Its distance from Baker's Park is only thirty-five miles by the trail. It is probably the richest little valley in the territory, and has an elevation of only 6,700 to 6,800 feet. It faces the south, and consequently is very warm, while at the same time it is near enough the mountains to get the benefit of their great rain-fall. Near its lower end good coal is found in the greatest abundance, while a plentiful supply of good pine timber is near at hand. Farther down the river the country becomes a plain, almost perfectly barren of vegetation. After passing through the park, we made several stations, west of the river, on low hills. On station 45, which is not represented on the accompanying map, but situated just a little below the border, we found some old ruins, consisting of a couple of watch-towers; one all disintegrated, leaving only a hole in the ground to indicate its presence, while the other still remained about four feet high, but was completely overgrown by oak-bushes. Some white and painted pottery lay about. This point is a wooded hill, east of the Rio La Plata. The day after, we found some pottery still farther north, on station 46, which is on the map. After this we followed a road which had been used by the former settlers, over to the Florida, and made

several stations near that stream. The road soon ended, and we followed its continuation, an Indian trail, to the Pinos River. This trail, by an oversight, was not represented on the map. It leaves the Animas about half a mile north of station 46, and thence over to the Florida, up which it follows for several miles, then strikes across to the Pinos, and crosses that stream at the mouth of the Vallecito; crossing thence over the next ridge, it strikes the Ute trail from Los Pinos agency. It is not much used, and is consequently quite hard to follow. There is some fine bottom-land on the Florida, capable of a high degree of cultivation, but of small extent. Near the junction of the Vallecito and Los Pinos is another small area of splendid land. These two streams running down from the quartzite peaks, run at least one-half more water than any other streams of the same *drainage* area in the district.

The next day after passing this point, October 2, snow began falling, and, camping near a peak on which we had to make a station, we quietly waited for the weather to clear off. By a remarkable accident we had halted in a splendid camping-place, there being none worthy the name for miles ahead of us, as we afterward found. Snow fell continuously for four days, and we found sitting in camp very hard work. On account of our peculiarly protected position the snow that fell near our camp melted as it fell, but a mile up stream it lay two feet deep. Had it not been for the good grass and shelter here offered, our wornout mules would have fared badly. A thing worthy of note is the fact that very slight thunder and lightning continued through the whole of this snow-storm. Lieutenant Wheeler narrates a similar experience in this part of the country. On the fourth day the weather cleared off, and we succeeded in making our station, though on the summit the snow was two or three feet deep, which, with our shoes nearly worn out, was very disagreeable. Returning early from the peak we moved up the ridge. The trail being entirely hidden by the snow we had to give it up, and after a very difficult day's march we only just succeeded in getting out of the snow, and then had to camp in swampy ground, making our beds on pine boughs, which we cut from the trees. We knew now that winter had commenced, and we wanted to get out of the mountains as fast as our mules could carry us. The next day we crossed the divide at the head of Los Pinos River, by way of the Ute trail. The pass this way was good, though covered with snow. In the summer it must be very easy and pleasant. We felt thankful when quite late in the afternoon we reached the Rio Grande and struck camp near the wagon-road. The next day we traveled down the road, which here is a very good one, to Antelope Park, which we found to be quite an extensive piece of plain country, forming here the Valley of the Rio Grande, and continued below, by a narrow strip of low land, along the river. The elevation of the park is about 9,000 feet. There are several houses dotted about over it and farms laid out, although the elevation is too great to allow much to be produced in the way of grain. The next day, October 9, we ascended Bristol Head and made station 54. This is a very curious bald mountain, a few miles east of Antelope Park, being the southern culminating point of a high plateau. To the east it slopes down quite gently, but on the west side it falls abruptly nearly 4,000 feet to the bottom of a very curious sink. In some places the bluff is quite vertical for over a thousand feet. Being composed of trachyte, the rock breaks off along vertical planes and gives to the precipice the character peculiar to volcanic formations. The sink already mentioned is a little valley from a quarter to half a mile broad, bor-

dered on the east by the high bluffs of Bristol Head; and, on the west, by a ridge and bluffs reaching seven to eight hundred feet above the valley. At the lower end a narrow gate-way leads out to the Rio Grande; and, at the upper end, a beautiful lake occupies the highest part. Just above this, Clear Creek cuts through the ridge on the west side, and flows out through Antelope Park. The whole mass of this basin has, undoubtedly, fallen in; and, at one time, Antelope Park must have jutted up against the side of the mountain. We made the ascent of the peak from the sink, but there is a much easier way up the east slope.

This was our last station. Passing down the Rio Grande we arrived at Del Norte October 10, and thence passing across the San Luis valley and taking the cars at Pueblo, on October 19 we reached Denver, our point of beginning.

METHODS USED IN DETERMINING THE ELEVATION OF POINTS IN THE DISTRICT.

All the elevations given in this report depend upon readings of a mercurial barometer. Where a standard barometer, whose elevation is well determined, is within a short distance, this instrument gives a very good determination of elevation. In the past summer, however, it was quite impossible to establish a base barometer in the vicinity of the region surveyed, without great expense. All the readings had to be referred to distant stations. Readings on high peaks were referred to the Signal-Service barometer on Pike's Peak, at an elevation of 14,147 feet above the sea, while readings on all points under 12,000 feet were referred to the barometer of the United States Geological Survey at Fairplay, whose elevation is 9,964.5 feet. The first of these is one hundred and fifty miles distant in a straight line from the central part of the San Juan country, while the second is one hundred and twenty-five miles distant. These distances are too great to give accurate results with the barometer. At several points in the region we succeeded in getting two readings at a point several days apart, but finding that the resulting heights, as calculated by reference to those distant bases, did not agree well enough, it was resolved to collect together all the data possible from the field-notes, and see if a fair trigonometric connection between the mountain peaks could not be established. The result was, under the circumstances, highly satisfactory. It must be remembered, however, that these observations were not taken with the object in view of making such a system of trigonometric levels. Moreover, the instrument used only read to minutes of arc. Supposing an error of a minute in a reading, which is not at all uncommon, the resulting error in the difference of level of two peaks from a single observation will be 15.3 feet for a distance of ten miles and 23 feet for a distance of fifteen miles. If, as is sometimes the case, the error be more than one minute, the error in the elevation will be still greater. Another large and uncertain element in the problem is refraction, which in the high mountains is so changeable as to add much to the uncertainty of the results. In many cases the observations were taken during storms, and often the peaks were sighted through breaks in the clouds, making the refraction still more uncertain.

In obtaining the following results, the plan adopted was this: from each station angles of elevation or depression were taken to the surrounding peaks and especially to previous stations. Had the fore sights and back sights between the several stations been simultaneous the error of the refraction correction would have been very nearly neutralized, but these two sets of observations were never taken at the same time, and in only one

case on the same day. From each of two stations I always succeeded in finding some peaks which had been sighted from both. With this material on hand the distances were obtained from Mr. Wilson's plot of his secondary triangulation which will not probably involve, in any case used, a greater error than five hundredths of a mile, which includes the error due to shrinkage of paper, as these distances were all hastily taken off from the map with a scale. Having then the horizontal distance between the two stations and the angle of elevation or depression from one to the other, of course the difference of level is determined. But on account of the errors which have crept into these angles from the causes above mentioned one determination of the difference of level is not sufficient. The back sight is then calculated, and brings a different result. For a still finer approximation, wherever vertical angles had been taken from the two stations to the same point, the height of that above and below each station was calculated. From this, another determination of the difference in the height of the two stations was determined. Then the height of another unvisited point was calculated, and so on for all the near points sighted from both stations. Each point gives one determination of the difference of the two stations. In some cases it will be found that one result is far out from the rest. This may be due to the fact that you have used sights to different points, which have received, by mistake, the same number in the notes. Such cases are thrown out, and a mean of the rest assumed as the true difference of level. It was found that, on account of errors of refraction and imperfections of the instrument, sights over fifteen miles could not be depended on at all. In the following calculations no sights of that length were used, and in fact very few over ten miles have been used at all.

For convenience in making the calculation, the following formula was used, taken from Lee's tables:

$$dh = 0.00000485 \text{ K A} \pm 0.000000667 \text{ K}^2$$

In which dh is the difference of level of the two points, K the horizontal distance in yards, and A the number of seconds in the vertical angle used. In this formula are contained corrections for both curvature and refraction, the latter element being assumed equal to 0.078 of the curvature. On examining the notes carefully it was found that there were sights to many hundred different peaks, and it became a difficult problem to utilize all this material, and at the same time do it according to a system. After a number of experiments on different methods it was found that to bring order out of this chaos, it was necessary to take up each link in the chain separately, and use all the data that could be found pertaining to it, and determine the difference of level of these two stations finally. Next, the same process was gone through with the line from the second point to the next station beyond, and so on. In doing this it was found that some of these lines were much better determined than the others. In finally reducing these differences of level to a common datum point, this fact might multiply the errors in the work. For instance, a number of well-determined differences of level might be transferred through a poorly-determined line, thus vitiating all with the error of the one. In order to obviate this the following scheme was adopted: A central chain of well-determined lines was carried through the heart of the mountain-mass from Mount Wilson, the most westerly of the high peaks, to station 8, five miles east of Uncompahgre Peak, in the northeast corner of the mass. From this main line several secondary branches were carried wherever the short lines could be well determined. This system covered the whole mass of mountains. Other stations, which could not be

well enough determined independently, were connected with different points in the main lines. In the central line we have the following parts: From Mount Wilson to station 30, a peak east of it and distant 9.3 miles, is a fall of 383 feet, which is the mean of five determinations having a range of 32 feet; thence east to Sultan Mountain, a distance of 6.88 miles, with a fall of 536 feet, the mean of six determinations, range 23 feet; thence northeast to station 16, distant 6.60 miles, a rise of 175 feet, the mean of nine determinations, range 35 feet; thence northeast to Handie's Peak, 7.51 miles, a rise of 456 feet, the mean of eight determinations, range 54 feet; thence north to Uncompahgre Peak, distant 11.14 miles, a rise of 238 feet, the mean of nine determinations, range 49 feet; thence east to station 8, distant 4.92 miles, a fall of 1,380 feet, the mean of ten determinations, range 67 feet. This completes the central or trunk line, whose length is 46.35 miles. From Sultan Mountain a branch was extended eastward; from this peak to station 25, distant 10.28 miles, a rise of 209 feet, the mean of twelve determinations, range 67; thence to Rio Grande pyramid, distant 8.63 miles, a rise of 197 feet, the mean of nineteen determinations, range 95.

From station 25, a branch extends to Mount Oso, distant 7.29 miles, a rise of 64 feet, the mean of seven determinations, range 37.

From station 30 a secondary branch was extended south and west.

Station 30 to Engineer Mountain, distant 6.98 miles, a fall of 926 feet, the mean of eight determinations, range 22; thence west to station 36, distant 6.76 miles, a fall of 417 feet, the mean of eleven determinations, range 51; thence to station 37, distant 3.65 miles, a rise of 94 feet, the mean of five determinations, range 35.

Another important subline extends from Sultan Mountain to the northwest. The first link in the chain is the line from this point to station 28. The heights of stations 30 and 16, above Sultan Mountain, having been already well determined from the central chain, I made use of all the connections between station 28, and each of these points, reducing all of them to a common point. The result from this was the following: Sultan Mountain to station 28, distant 7.86 miles, a fall of 484 feet, the mean of eighteen determinations, range 76 feet; thence to station 29, distant 3.77 miles, a rise of 324 feet, the mean of eight determinations, range 43 feet; thence to Mount Sneffels, distant 5.94 miles, a rise of 952 feet, the mean of six determinations, range 36 feet; thence to station 34, distant 6.65 miles, a fall of 1,161 feet, the mean of five determinations, range 23 feet.

This completes all the well-determined chains. Other stations on which barometric readings had been taken, were connected with as many points in the main lines as possible, and these being reduced to a common point a mean was taken. Such points are the following: Sultan Mountain to station 10, a fall of 223 feet, the mean of eleven determinations, range 76 feet; Uncompahgre Peak to station 5, a fall of 1,498 feet, the mean of ten determinations, range 85 feet. Uncompahgre Peak to station 11, a fall of 3,624 feet, the mean of eight determinations, range 111 feet; Sultan Mountain to station 51, a fall of 835 feet, the mean of three determinations, range 75 feet; Sultan Mountain to station 48, a fall of 1,061 feet, the mean of six determinations, range 59 feet; Handie's Peak to station 13, a fall of 1,175 feet, mean of fore and back sights, range 6 feet.

Besides these there are two which depend on single determinations: First from Sultan Mountain to the point in Baker's Park where the road crosses Cement Creek in Silverton, distant three miles, a fall of 3,961 feet. Second, from Mount Sneffels to station 32, which is obtained from sights to a common point between them, distant from Mount

Sneffels 2.04 miles, and from station 32 3.75 miles. The fall is 5,050 feet. This difference of level is checked by sights to distant points to the south of station 32. These two cases are admitted, because the distances were so short as to preclude the possibility of any considerable error.

From all these results a table was made out, showing the heights of each station above or below a common datum-point. Sultan Mountain was selected to perform this latter function, from its central location, and also from the fact that it was situated on the great central chain of levels at its junction with the two principal sublines.

A second column was added, giving the height of each station as determined by the single barometric reading taken thereon. A third column was made out by means of the first two by adding the number in the first column to the one in the second when preceded by the minus sign, and by subtracting it when plus. This column now represents the elevations above sea-level of Sultan Mountain, as determined from the barometric readings at the several stations. It will be seen that the twenty-three results have a range of 203 feet. A mean of all these was assumed as the true height of Sultan Mountain, and by reversing the previous process and adding the plus differences of height in the first column and subtracting the minus, a fourth column was obtained, giving the elevation of each station as reduced from the mean of the twenty-three readings. A fourth column was added, giving the date of each reading on the different stations. From this it will be seen that the observations extend from August 1 to October 6, more than two months.

By examining the table carefully it will be seen that nearly all the earlier readings give heights above the mean, and the later below it. Whether this is merely accidental or due to some physical law, I cannot tell. It will be seen that several of those stations, whose height relative to the rest has been well determined, do not appear in the table. This is due to the fact that at those stations, either from storms or other causes, we failed to get barometric readings.

Name of station.	Height above or below Sultan Mountain.	Absolute height of station from barometric reading.	Resulting height of Sultan Mountain.	Final height of station.	Date of barometric reading.
					1874.
Station 5	—629	12,770	13,399	12,737	Aug. 1
Station 8	—511	12,960	13,471	12,855	" 6
Uncompahgre Peak	+869	14,337	13,468	14,235	" 8
Station 10	—223	13,082	13,305	13,143	" 10
Station 11	—2,755	10,684	13,439	10,611	" 12
Station 13	—544	12,895	13,439	12,822	" 14
Handie's Peak	+631	14,101	13,470	13,997	" 15
Station 16	+175	13,593	13,418	13,541	" 17
Rio Grande Pyramid	+407	13,801	13,394	13,773	" 22
Sultan Mountain	0	13,298	13,298	13,366	" 31
Silverton	—3,961	9,377	13,338	9,405	" 31
Station 27	—777	12,491	13,268	12,589	Sept. 3
Station 29	—160	13,120	13,280	13,206	" 4
Station 30	+531	13,927	13,396	13,897	" 6
Station 32	—4,258	9,027	13,285	9,108	" 9
Mount Sneffels	+792	14,162	13,370	14,158	" 10
Station 34	—369	12,988	13,357	12,997	" 11
Mount Wilson	+914	14,185	13,271	14,280	" 13
Station 36	—812	12,538	13,350	12,554	" 14
Station 37	—718	12,623	13,341	12,648	" 15
Station 38	—320	13,014	13,334	13,046	" 20
Station 48	—1,061	12,321	13,382	12,305	" 30
Station 51	—835	12,518	13,353	12,531	Oct. 6
Mean	....	....	13,366		

With the elevations of these stations determined, the heights of unvisited points were obtained by applying the difference of level, as obtained from the vertical angle, to the height of the station from which the angle was taken. As most of the unvisited points are sighted from many stations, we have for each a number of determinations of which the mean is taken. Many of these points are quite as well determined as some of the stations.

As it was impossible to connect all the peaks with the scheme of trigonometric levels, it was thought best to give the heights of such as near as it could be obtained from the data at hand.

All these, it must be understood, depend on a single reading of the mercurial barometer, not of the small aneroid. The latter instrument was found to be worse than useless. Only one height depends on an aneroid reading, that is Bear Creek Pass, but as here we had two different sets of readings of three different aneroids, compared each morning with the mercurial barometer, I thought best to put the height in the list, but it must not be considered as very accurate.

In the following table are given as nearly as may be, the heights of all the peaks in the San Juan country above 13,000 feet, besides stations and other points of interest. Some of the latitudes and longitudes have been calculated, while the others have been taken from Mr. Wilson's plot of his secondary triangulation, at a scale of two miles to one inch. Some of these peaks being points of the primary triangulation, their latitude and longitude will be more accurately determined when that work is finished.

The first column in the table indicates the topographical designation of each peak. The double numbers indicate unvisited stations. For instance, 14—9 signifies the fourteenth point sighted from station 9, which ever afterward bears that designation unless occupied as a station. The term "Baker's Park rectangle" signifies the projection rectangle included between latitude 37° 45′ and 38° and longitude 107° 30′ and 107° 45′, in which Baker's Park is situated. On the map the name, by a sad oversight, was omitted, but its position may be known from the fact that Howardville and Silverton are situated within it.

Baker's Park rectangle.

Name or number of peak.	Height above the sea.	Latitude.			Longitude.		
		°	′	″	°	′	″
Station 17	12, 897	37	45	32	107	33	30
2—17	13, 390	37	46	00	107	36	8
Sultan Mountain	13, 366	37	47	15	107	42	2
Mount Kendall	13, 380	37	47	22	107	36	51
10—16	13, 300	37	47	41	107	37	30
11—16	13, 030	37	47	45	107	38	20
8—16	13, 400	37	47	57	107	35	47
6—14	13, 450	37	48	2	107	32	32
Galena Mountain	13, 290	37	50	2	107	34	8
Station 16	13, 541	37	51	30	107	37	10
13—14	13, 480	37	51	37	107	39	8
2—15	13, 360	37	51	44	107	35	48
Station 27	12, 589	37	52	21	107	41	58
12—9	13, 770	37	53	27	107	31	49
11—9	13, 830	37	53	57	107	31	18
Station 28	12, 882	37	54	7	107	41	10
17—14	13, 390	37	54	33	107	36	24
11—27	13, 630	37	54	39	107	44	52
Handie's Peak	13, 997	37	54	50	107	30	4
2—10	13, 440	37	54	55	107	37	6
Station 15	13, 675	37	56	42	107	33	20
1—10	13, 720	37	56	57	107	32	3
3—10	13, 770	37	57	2	107	32	48
Station 29	13, 206	37	57	24	107	41	58
3—8	13, 480	37	57	50	107	29	35
5—26	13, 120	37	58	12	107	41	11
8—5	13, 290	37	58	27	107	35	11
5—10	13, 787	37	59	30	107	44	48
Station 10	13, 143	37	59	40	107	35	39
1—5	13, 250	37	59	47	107	30	20
12—10	13, 420	38	00	12	107	44	23
57—9	13, 120	38	1	16	107	37	5
13—10	13, 490	38	1	17	107	44	6
14—10	13, 080	38	1	46	107	43	49
21—1	13, 970	38	3	42	107	30	30
10—10	13, 010	38	4	52	107	31	52

West of Baker's Park.

Name or number of peak.	Height above the sea.	Latitude.			Longitude.		
		°	′	″	°	′	″
9—31	13, 120	37	44	54	107	51	51
1—9	13, 740	37	45	27	107	51	31
32—9	13, 697	37	46	00	107	49	23
21—30	13, 377	37	46	6	107	47	18
20—30	13, 420	37	46	15	107	46	58
22—30	13, 730	37	46	47	107	52	7
23—30	13, 180	37	47	42	107	52	54
Station 30	13, 897	37	48	2	107	49	31
6—27	13, 760	37	49	28	107	48	18
4—27	13, 170	37	49	33	107	46	6
5—27	13, 400	37	49	34	107	47	3
Lizard's Head	13, 160	37	50	13	107	56	51
Lizard's Head, base of column	12, 868	ditto.			ditto.		
7—27	13, 400	37	50	16	107	47	12
Mount Wilson	14, 280	37	50	23	107	59	18
1—35	14, 195	37	50	25	108	00	7
4—9	14, 050	37	51	40	107	58	54
8—27	13, 650	37	51	50	107	46	31
3—30	13, 690	37	52	27	107	48	22
2—30	13, 480	37	52	46	107	49	41
9—27	13, 470	37	53	27	107	45	7
10—27	13, 550	37	53	57	107	45	00
Station 32	9, 108	37	57	12	107	52	20
1—29	13, 590	37	58	38	107	47	12
14—30	13, 810	37	59	20	107	49	15
2—29	13, 750	37	59	26	107	47	53
12—30	13, 730	37	59	38	107	50	48
Mount Sneffels	14, 158	38	0	17	107	47	21
11—30	13, 500	38	00	36	107	51	33
Station 34	12, 997	38	1	54	107	54	23

Quartzite Peaks, south of Baker's Park.

Name or number of peak.	Height above the sea.	Latitude.			Longitude.		
		°	′	″	°	′	″
Station 48	12,305	37	29	20	107	35	56
9—23	13,650	37	34	55	107	28	42
21—31	13,000	37	34	57	107	40	18
10—23	13,275	37	35	12	107	29	6
11—23	13,110	37	35	48	107	30	18
8—23	13,380	37	35	52	107	29	2
Mount Oso	13,640	37	36	29	107	29	25
9—21	13,630	37	36	31	107	34	24
13—23	13 180	37	36	41	107	27	25
1—23	13,800	37	36	48	107	34	44
2—23	13,580	37	37	9	107	32	59
7—9	14,054	37	37	21	107	35	21
Mount Aeolus	14,054	37	37	24	107	37	12
8—9	14,033	37	37	43	107	35	32
1—39	13,728	37	37	43	107	38	16
Pidgeon's Peak	13,928	37	38	2	107	38	36
10—21	13,746	37	38	40	107	37	27
11—21	13,783	37	38	49	107	34	51
1—14	13,560	37	39	52	107	32	14
5—23	13,680	37	39	52	107	35	18
1—38	13,100	37	39	54	107	43	22
5—14	13,600	37	40	18	107	34	36
2—14	13,580	37	40	19	107	32	42
4—14	13,650	37	40	27	107	34	00
3—14	13,700	37	40	43	107	33	24
12—14	13,800	37	40	52	107	35	18
9—14	13,750	37	40	57	107	34	47
16—14	13,730	37	41	12	107	35	22
7—14	13,831	37	41	27	107	35	56
8—14	13,800	37	41	42	107	36	25
4—17	13,540	37	41	56	107	33	18
Station 38	13,046	37	41	59	107	41	20

Southeast of Baker's Park.

		°	′	″	°	′	″
Station 51	12,536	37	29	52	107	22	24
Station 22	13,020	37	36	6	107	23	48
11—17	13,090	37	39	38	107	29	11
10—17	13,200	37	40	38	107	29	40
12—17	13,170	37	40	39	107	30	15
Rio Grande Pyramid	13,773	37	40	50	107	23	21
3—18	13,220	37	41	24	107	22	17
9—17	13,090	37	41	20	107	29	57
Station 24	12,957	37	41	46	107	29	55
2—18	13,210	37	41	55	107	21	56
7—17	13,310	37	42	14	107	28	38
8—17	13,260	37	42	16	107	29	29
14—14	13,430	37	42	47	107	27	18

East of Baker's Park.

		°	′	″	°	′	″
Station 20	12,050	37	46	58	107	19	36
Mount Canby	13,274	37	47	7	107	30	51
Station 18	13,656	37	47	52	107	25	42
10—18	13,614	37	48	54	107	26	36
8—1	13,530	37	51	34	107	23	57
12—1	13,815	37	51	58	107	27	54
10—13	13,747	37	54	40	107	28	42
Station 13	12,822	37	55	27	107	28	15
Station 12	13,967	37	55	30	107	25	21
15—1	14,004	37	56	36	107	25	6
4—3	13,780	37	56	56	107	23	42
16—1	13,540	37	57	17	107	25	00
3—3	13,700	37	57	24	107	22	30
6—13	13,600	37	57	52	107	25	10
2—3	13,620	37	57	55	107	21	21
18—1	13,520	37	58	28	107	26	18
17—1	13,660	37	58	53	107	25	24
Station 11	10,611	38	1	34	107	17	36
Station 5	12,737	38	2	00	107	14	24
Station 8	12,855	38	3	16	107	22	18
14—5	13,510	38	3	57	107	29	38
Uncompahgre Peak	14,235	38	4	21	107	27	32
24—1	13,670	38	6	27	107	26	44
31—1	13,080	38	7	21	107	27	18

Miscellaneous elevations.

Name or number of peak.	Height above the sea.	Latitude.			Longitude.		
		°	′	″	°	′	″
Station 2*	13,560	37	58	12	107	4	3
Station 3*	12,670	38	7	42	107	12	35
Station 7*	9,100	38	16	48	107	9	6
Engineer Mountain	12,971	37	42	4	107	48	12
Station 36	12,554	37	42	48	107	55	37
Station 37	12,648	37	41	19	107	14	11
Station 39	10,613	37	35	12	107	49	55
Station 42*	10,580	37	25	40	107	55	42
Station 44*	8,100	37	16	45	107	49	20
Station 45*	8,300	37	11	18	107	59	24
Station 47*	8,930	37	19	35	107	42	15
Bristol Head*	12,800	37	47	45	107	3	6
Howardville	9,700	37	50	12	107	35	42
Silverton	9,400	37	48	48	107	39	40
Lake Fork Pass*	12,540						
Cunningham Pass*	12,090						
Pass east of Sultan Mount*	10,460						
Pass west of Sultan Mount*	11,570						
Pass at head of Mineral Creek*	11,098						
Bear Creek Pass (*a*)	12,600						
Weminuche Pass*	10,170						

The star denotes points whose heights depend on a single reading of mercurial barometer.
(*a*) Height determined by aneroid barometer.

NOTES USEFUL FOR THE LOCATION OF MINERS' MONUMENTS IN BAKER'S PARK.

Sultan Mountain is the peak at the south end of Baker's Park. In the following notes the monument built by this party on the southern knob is used as the station. Station 16 is a high massive peak, two miles northwest of Howardville, but not quite visible from the town; it may be seen from a point a little up the side of Galena Mountain. On the summit we left a small monument of stones. The latitude of station 16 is 37° 51′ 30″.5, and its longitude 107° 37′ 9″.8. The latitude of Sultan Mountain is 37° 47′ 15″, and its longitude 107° 42′ 1″.5; at station 16, Sultan Mountain, bears south 42° 11′ west; at Sultan Mountain, station 16 bears north 42° 8′ east. The distance between the two points is 6.60 miles. By using this as a base any engineer can locate accurately a monument at any point visible from the two stations. Silverton and the whole lower end of the park are visible from both points, as well as points on the side of Galena Mountain, and also others near Arastra Gulch.

Declination of magnetic needle.

Locality.	Declination.	Date.
		1874.
Station 11	E. 15° 15′	August 12
Rio Grande Pyramid	E. 12° 56′	August 22
Station 30	E. 8° 59′	September 6
Engineer Mountain	E. 13° 56′	September 7
Station 32	E. 15° 59′	September 9
Station 34	E. 16° 55′	September 11
Mount Wilson	E. 13° 8′	September 13
Station 36	E. 16° 15′	September 14
Station 37	E. 14° 23′	September 15

NOTE ON SOME PECULIAR FORMS OF EROSION IN EASTERN COLORADO, WITH HELIOTYPE ILLUSTRATIONS.

By F. V. Hayden.

The two plates, VII and VIII, to which the attention is directed in this brief note, have been printed by the heliotype process of J. R. Osgood & Co., of Boston, Mass., and are introduced in this connection as an experiment. Necessarily, they present the accuracy, fidelity, and detail of the original photograph, and on that account will be studied by geologists with interest. They illustrate two distinct forms of erosion, the rocks belonging to widely different geological epochs. The power of the atmospheric agents in giving form to the surface-features in regard to magnitude as well as variety, is nowhere more strikingly manifested than in Colorado. We hope from time to time to publish selections from the more instructive of the scenic views, to illustrate these unique forms of earth sculpture.

In Plate VII, entitled "Picturesque pine and Castellated rocks," are shown some most singular castellated sandstones, from forty to sixty feet in height, located just south of the divide, near the head of Monument Creek, within a short distance of the base of the mountains. For a distance of about twenty-five miles in this region the sandstones of the lignitic or Monument Creek group, jut up against the granites of the mountain foot-hills with a comparatively slight inclination, varying from 5° to 15°. For this distance, the sandstones lap on to the granites, showing but little change in the elevation since their deposition. They show clearly that the Colorado range had reached nearly its present height prior to the deposition of the lignitic group. All the rocks of older date are concealed, from a point south of Monument Creek north, across the "divide" to the south portion of the drainage of the South Platte. These isolated columns, of which there are only a few, are very interesting, as remnants of beds that originally extended over a large area, but have been removed by erosion. It is not at all probable that they represent the original thickness of these beds; for in the plains, some miles to the eastward of the base of the mountains, are numerous high buttes, that would indicate that at least one thousand to fifteen hundred feet of the lignitic strata had been removed. Though differing much in form, these columns are of the same geological age with those which occur in Monument Park, farther to the southward, and are well shown in the annual report of the survey for 1873, page 32, Figures 4 and 5. The sediments vary much at different localities, being sometimes quite fine, of a yellowish cream-color, and again, a rather coarse aggregate of small pebbles or grains of quartz, without much coherence. The atmosphere acts with considerable ease on these rocks, carving them into a great variety of forms. In the foreground we see a crooked pine-tree, peculiar to this region, and at the right upper corner the sun shining through the leaves, or really the sun itself. The character of the surrounding surface, with the peculiar vegetation, is also seen. The columns present a kind of ribbed appearance in the picture. This is due

to the wearing out of the softer parts along the lines of the bedding. The dip is to the east about 5°.

In Plate VIII, "Profile rocks, Pleasant Park," we have a group of sandstones, at least as old as the Jurassic, and probably of Carboniferous age. These are located much farther to the north, near the sources of Plum Creek, a branch of the South Platte. We have here a pretty full series of the sedimentary beds exposed by the upheaval of the mountains. Although no fossils could be found, it is quite possible that the variegated sandstones resting on the granites are Lower Silurian, while the deep purple sandstones shown in the picture are Carboniferous, and close to them, extending off to the eastward, are the brick-red sandstones, doubtfully of Triassic age. Triassic beds may occur along the east slope of the Rocky Mountains, but as yet we have no proof of their existence, and, therefore, when we refer to them it is with doubt. From the sources of Plum Creek to the South Platte Cañon, a distance of twenty miles, there is a belt of country about half a mile in width, in which these eroded sandstones present great variety of forms, some of which are shown in the plate. The rocks vary much in texture, from a fine-grained sandstone to a rather coarse conglomerate. The irregular laminæ of deposition are quite remarkable, showing that the entire group of sediments was deposited in moving waters. The strata themselves vary much in texture within a few feet, and on this account the forms are much varied. Deep cavities are worn out of the sides where the materials were softer than the surrounding parts. In the background the dim outline of the granite foot-hills of the Colorado range is well shown. These sandstones form a portion of what are called the "Hog-backs," in the West. They form one of the inner ridges which are so common all along the immediate base or foothills of the mountains. The scenery along the base of the Colorado range, of which Plate VIII illustrates a small portion, will always be regarded with the greatest interest, not only by the tourist but also by the geologist. It has its parallel in no other country of which we have any knowledge, either from personal examination or from the descriptions of other explorers.

PLATE VII.

"PICTURESQUE PINE AND CASTELLATED ROCKS," representing a form of erosion of he sandstones of the Lignitic or Monument Creek group, Colorado.

PLATE VIII.

"Profile Rocks, Pleasant Park, Colorado," red and variegated sandstones, most probably of Carboniferous age, exposed along the immediate base of the Rocky Mountains by the elevation of the Colorado or Front Range.

DEPARTMENT OF THE INTERIOR.

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NOTES ON THE SURFACE FEATURES OF THE COLORADO OR FRONT RANGE OF THE ROCKY MOUNTAINS.

By F. V. Hayden.

The geological structure of the eastern base of the Rocky Mountains, from Cheyenne to Pueblo in Colorado, has been so carefully studied that but little more can be said that will have the air of novelty. It remains now to present to the eye a more connected view of the topographical features of this region, thus rendering much clearer many points in the geology. The beautiful and accurate illustrations of Mr. Holmes which accompany these notes will convey a clearer conception to the minds of geologists, of the topographical forms, as well as the geological features, of this interesting portion of Colorado, than pages of mere description. With these views before the reader the detailed investigations of Mr. Marvine, Dr. Peale, and Dr. Endlich, as well as those of the writer, in the annual reports for 1873 and 1869, will be far better understood. Therefore, it will not be necessary to repeat in this connection the details of the geology of this region, but the reader is referred to the series of annual reports. Plate IX represents the great Colorado or Front range of mountains, as seen from a point near Denver, commencing north just beyond the northern boundary of Colorado and extending south to Pike's Peak, a distance of about eighty miles in a straight line. In the foreground we see what are termed the plains, a broad rolling surface, gradually sloping from the base of the mountains eastward. The dotted line marks the boundary between the sedimentary strata and the Archæan or Metamorphic rocks which form the nucleus of the range. At different points the uplifted ridges, which are termed in the West " Hogbacks," can be distinctly seen. This view was taken twenty miles or more to the eastward of the immediate base of the mountains, and therefore only the higher ridges were visible to the eye of the artist, but their character can be well understood from these sketches. North of the North Boulder Creek, at *l*, *l*, the ridges of red sandstone with Cretaceous No. 1 are well exposed near the base of the range, but are not shown in the sketch ; between the North and South Boulder Creeks at *l*, *l*, and *h*, are some of the most conspicuous ridges of sandstone that are known to occur along the foot of the Rocky Mountains, from latitude 49° south to Santa Fé. They rise to a height of 1,500 feet above the plains at their base. It is difficult to account for the manner in which they have been protected from erosion. It is quite possible, however, that it is due to the fact that they have been partially metamorphosed by heat, and hence their greater hardness renders them less amenable to the influence of the atmospheric forces. That these ridges, all along the base of the mountains, were originally much higher and may have even extended far up the mountain-sides, but have been removed by erosion, there is ample evidence. In many instances they seem to have been almost entirely removed for considerable distances, and again they rise 200 to 500 feet, seldom more,

except in this instance. The inclination of these sandstone ridges varies much in different localities. Sometimes they stand nearly vertical. They may be said to incline at all angles from 5° to 80° from the granitic mass. It will be seen that these sketches illustrate a very important point, which has been often repeated in my former reports, the rising of the great mountain-ranges suddenly or abruptly out of the plains. In the foreground we have the Lignitic beds inclining at a very small angle, within a short distance from the granites, varying from a half mile to two miles in width, seldom more. We may infer, therefore, that the force that elevated the mountain-range acted nearly or quite vertically. Whenever the inner ridges stand at a high angle, the beds have been undoubtedly broken off abruptly close to the granite foot-hills, as is well shown at Boulder Creek, and at Pike's Peak in the "Garden of the Gods." The illustration of this vertical uplift of the sedimentary beds, by which they seem to have been broken off abruptly, forming a right angle, as it were, is very common along the base of either side of the eastern range of the Rocky Mountains. In some instances a nucleus of granite will be surrounded with a narrow belt of nearly vertical beds of sedimentary rock, and within a few hundred feet the same vertical strata will lie in a nearly horizontal position. Some of the most important coal-beds in Colorado are opened within a mile east of the granite nucleus in the drainage of the Boulder Creeks, the strata of the coal group inclining at angles of not more than 10° to 15°, and very soon flattening down to a nearly or quite horizontal position still farther to the eastward.

Let us examine the sketch from Denver. To the west, about ten miles, are two quite remarkable table-mountains capped with basalt. Underneath their basaltic caps there is a great thickness of the Lignitic beds, evidently protected from erosion by the hard bed of basalt over them. The valley of Clear Creek separates the two. That they originally formed one bed and spread over a much larger area than at present, seems probable. Between these table-mountains and the granites, the distance is not over a mile in a straight line, and yet there is a thickness of 1,500 feet or more of Lignitic beds, with an important coal-seam, with a series of Cretaceous, Jurassic, and red sandstones, or Triassic, in regular order to the granites. These mountains, with the geology in the vicinity, were described by me in the third annual report of the survey, 1869, and much more in detail, with illustrations by Mr. Marvine, in the seventh annual report of the survey for 1873. From Denver, southward of the Platte Cañon, the ridges are well shown in the sketch just under the dotted line. At a distance, there would appear to be not more than one main ridge, but there are usually several of them, with beautiful valleys between. There are many fine farms among these ridges, and the settlers are very numerous at this time. South of the Platte Cañon there is a narrow belt of the red sandstones extending for about five miles that have been worn into most remarkable picturesque forms, presenting as great a variety, even, as the celebrated "Garden of the Gods," at Colorado Springs. The red sandstones are protected from the plains by a continuous ridge of the Cretaceous sandstones of the Dakota group, while, between that ridge and the granites, there is a belt between a fourth and half a mile in width, in which the red sandstones present a confusion of broken ridges, with their sharp edges projecting above the level, grassy surface, from a few feet to 150 feet in height, with an inclination from the granite mass of 45° to 50° to the east. For this entire distance the Red beds, or Triassic, (?) as they have been usually termed, rest on the granitic rocks. The rolling plains in the

foreground are underlaid with Lignitic strata, oftentimes covered with a great thickness of drift composed of sands and rounded boulders, varying in size from a small pebble to 10 feet in diameter. The rounded masses are usually quite small. The city of Denver is built on the Lignitic beds, lying nearly or quite horizontal.

This pictorial section, as well as the one shown on Plate X may be studied with great advantage from several points of view. They present to the eye the relations of the plains with the great mountain-ranges. We can see how the mountains appear to the traveler, approaching them from the eastward, to rise abruptly out of the plains. Denver is 5,197 feet above sea-level, and yet many of the peaks of this great front range, which rises up like a vast massive wall, send their summits above 14,000 feet. The simplicity of the structure of the eastern range, in a general way, is well presented in these sketches. The upturned ridges along the immediate base on the east side, and in some instances on the west side, inclining in opposite directions, show the simple action of a vertical force with very slight tangential movement. In the case of the Laramie range, west of Cheyenne and the Black Hills of Dakota, the full series of sedimentary strata present their uplifted edges on either side of the granite nucleus, so that we cannot resist the conclusion that, prior to the elevation, the sedimentary beds extended in unbroken continuity across the area now occupied by the metamorphic central mass; the missing portions having been removed by erosion during the slow, long-continued process of elevation.

Although there is apparently so much simplicity in the dynamics of these eastern ranges, the details of structure are very complicated and varied. Perhaps the most important lesson taught by these sketches is the great variety of forms resulting from erosion. The glacial period in the Rocky Mountain region has passed away, but it has left everywhere most wonderful exhibitions of its power. Even the highest peaks have suffered more or less degradation, and it is hardly possible to estimate the amount of material which has been worn from the great central granitic mass. Water and ice are still at work diminishing the height of the loftiest ranges, and yet the forces now in operation are very feeble compared with those which performed the work during the glacial period. Indeed, we may presume that the work of degradation commenced as soon as the area now occupied by the mountain ranges arose above the sea; and, therefore, the work of destruction of the original forms has been going on for an almost unlimited period of time, dating back nearly or quite to the Carboniferous period. We may therefore conclude that the present remarkable forms which Mr. Holmes has so accurately and beautifully depicted, are the later results of the handiwork of nature, in her task of earth-sculpture. All through these ranges of mountains are myriads of deep gorges, the channels of the many small streams that, uniting in the plains, form our large rivers. All of these show conclusively that they have been carved out to a greater or less extent by erosion. On either side of the mountain crests are huge amphitheaters, filled with vast quantities of *débris* of broken rocks, the wearing back, toward the crest, of these channels by the combined action of water and ice. There are also numerous oval areas, usually called parks, varying in size from a few acres to many square miles, which have also been worn out to a great extent by glacial action. Vast quantities of drift, morainal deposits, terminal and lateral, are in most cases found in these mountain valleys, detailed descriptions of which appear in our reports, from time to time. All along the base of the mountains this local deposit is most

abundant, and it extends far out into the plains. To show its local character we may state that the materials become gradually finer as we recede from the place of their origin. Toward the mountain crest or divide, the local drift is very coarse, made up of blocks scarcely worn; these diminish in size and become more and more rounded by attrition as we move from the crest. Pike's Peak, which towers so loftily over all the other summits in the vicinity, is covered on its top and sides with broken masses. High above timber-line, the sides of the peak are covered with a heavy thickness of glacial drift, forming a fine earth, upon which a thick matting of grass and other herbaceous vegetation is growing. Small lakes surrounded with morainal ridges occur above as well as below timber-line.

The sedimentary ridges along the foot of the mountains, as is shown in the sketch, are cut through at right angles, at short distances, by the numerous little streams that flow down from the mountains into the plains. Most of these channels are dry the greater part of the year. These also show that the erosive action has greatly decreased in modern times. We may therefore infer that, so far as surface forms are concerned, there has been nothing permanent but change; that the process of degradation has gone on from the beginning with varied degrees of power, and that it is going on now continually, but with greatly diminished force.

In describing briefly Plate X, we may commence at the right hand or north end; we see in the distance the source of Monument Creek in the divide which separates the drainage of the Arkansas River from that of the South Platte. The coarse sediments of the Monument Creek group usually jut up against the granite foot-hills with very little inclination, as if the elevation had been very slight since the deposition of the Monument Creek beds. In the foreground near the pine tree, are the bluffs of Lignitic sandstones, which overlook the valley of Monument Creek, and once extended across to the foot-hills of the mountains. At *n* is West Monument Creek, which, with its numerous branches, has carved out broad valleys, as they came down from the mountains, leaving, either in groups or isolated columns, those singular forms figured in the annual report for 1873, opposite page 32, and on this account have suggested the name of Monument Park. At *v* we have the isolated castellated columns seen in the heliotype Plate VII, in Bulletin No. 3. About midway in the profile at *p*, are Austin's Bluffs, a part of the coal or Lignitic series, dipping northeast at an angle of about 8°, and extending off to the northwest, so as to lap on to the granite foot-hills. At the left-hand corner, a portion of the same sandstones seen at the right-hand corner and in the center of the foreground, are shown, with something of the peculiar style of weathering of the Monument Park sandstones. The layer which caps the column, is an iron-rust colored sandstone, harder and less yielding than the portions below. The oxide of iron seems to have cemented the grains of sand and small worn pebbles into a hard rock. Here we have the lowest beds of the Lignitic group, and nine miles east of Colorado Springs, underneath these sandstones, are thick beds of coal, amounting in the aggregate to 20 feet or more. In the valley of Monument Creek, *t*, *t*, the Cretaceous clays are exposed by the denudation of the Lignitic beds, and numerous species of *Ammonites*, *Scaphites*, *Inocerami*, &c., are found. These coal or Lignitic beds once extended uninterruptedly across to a point very near the base of the mountains, and in all probability were connected with the coal-beds at Cañon City, on the Arkansas, a distance of thirty miles in an air line, southwest. The mesa, *k*, *k*, separates Monument Creek from Foun-

tain Creek, and is underlaid with Upper Cretaceous beds, Nos. 4 and 5, with a thick covering of rather coarse drift. This is a most beautiful plateau, overlooking the plain country in every direction. At the point of the mesa, at the left hand, the two creeks unite; only Cretaceous clays of Nos. 4. and 5 are seen.

The Lignitic beds pass very soon beneath a more modern group of rocks, which in the annual report of the survey for 1869 I called the Monument Creek group. North and west of Colorado Springs are a number of extensive coal-beds, and in the sandstones above and below a considerable variety of the peculiar fossil plants have been observed. We know that a great thickness of the Lignitic group is here represented, and in following the valley of the Monument Creek up to the northward no want of conformity between the Lignitic and the Monument Creek groups could be observed. I do not doubt, however, that on the "divide" between the drainage of the Arkansas and the South Platte Rivers there is a group of beds of quite modern date entirely distinct from the Lignitic group, which must bear the name of Monument Creek group. I desire here to correct a statement in Bulletin No. 3, page 210, that the two groups, could possibly be identical; also to correct the description of Plate VII, which is an illustration of the more modern group.

In all cases where I have observed the Lignitic strata near the base of a mountain range, they have partaken fully of the uplift, and incline at high angles usually from the range, but it is not an uncommon thing for the modern Tertiaries to jut up against the granites, or to incline at small angles, from 5° to 15°. It was on this account that I pronounced the Monument Creek group, in 1869, Middle Tertiary or Miocene, and, although differing in lithological character, probably contemporaneous with the White River group farther to the northward, and holding the same relations to the mountain ranges. Professor Cope, in the annual report for 1873, page 430, says that the few vertebrate remains which he discovered in this group show conclusively that it is newer than the Eocene. We know but little of this modern group as yet, and we hope hereafter to secure more definite evidence of its age as well as its relations to the South Park basin and other lake-basins in the West.

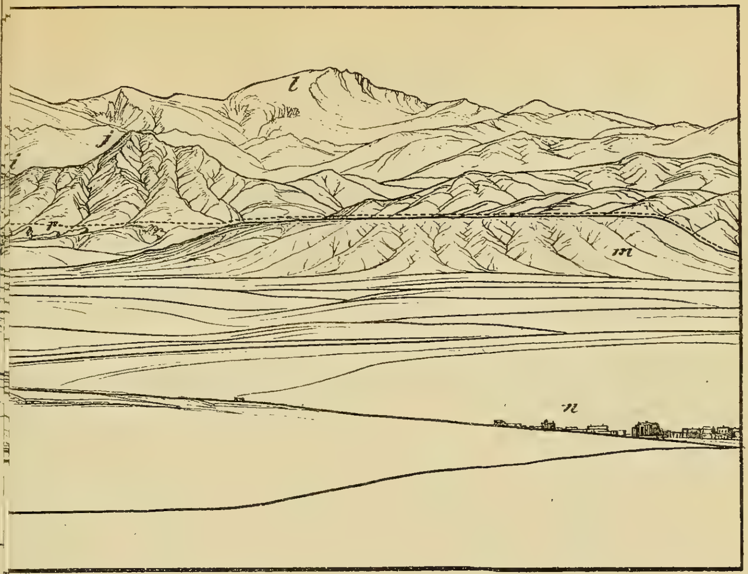
If we look closely under the mountains, about the middle of the profile, we shall see the upturned edges of the sandstones that form a portion of the celebrated "Garden of the Gods." The brick-red sandstones are probably better shown here than at any other locality, and the unique forms which they have received from atmospheric erosion have earned for them their peculiar appellation. In the annual report for 1873, opposite page 200, is a pictorial and anatomical section, which strikingly illustrates the position of the rocks in this region. It will aid the reader much in understanding this profile to read this report. To the left of *y* there is a ridge, lapping on to the side of the mountain, elevated at a high angle, with four cone-shaped points; these are Silurian limestones, which are well exposed in the vicinity of Manitou, near the source of Fountain Creek. Above this point the Monument Creek group juts up against the granites, concealing all the formations of older date. The lessons taught by this profile are much the same as those so well shown in the preceding plate, IX. The mountains seem to rise abruptly out of the plains, as if the vast granitic masses had pushed their way up vertically through the overlying crust, or sedimentary group of beds. At the very base of the mountains, for a portion of the distance, the entire group of sedimentary beds is tipped up at various angles, but in a very short distance eastward from the range only the coal group is seen in a horizontal position. The peculiar forms, both in the mountains and the

plains, have been represented by Mr. Holmes with wonderful accuracy and fidelity, and in among the high peaks are the usual gorges or cañons, and all the proofs of terrific erosion in past times.

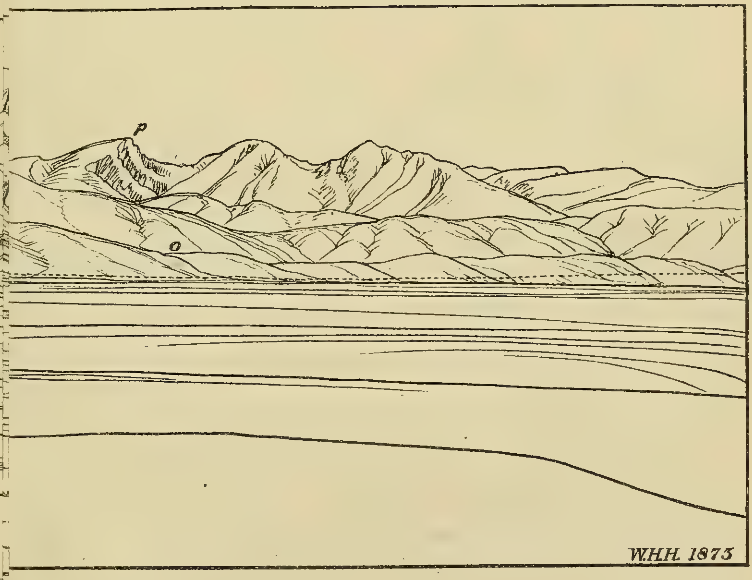
An important fact, however, is illustrated by the profile, which, so far as I know, was first observed by me in 1869 and published in the annual report of that year—that is, the dying out of the mountain-ridges in the plains. The great ranges are usually composite in their character, that is, are made up of a number of smaller ranges. These minor divisions may be continuous for long distances or may break off suddenly, and form some other ridge. The general trend of the aggregate mass of the eastern Rocky Mountain group is slightly west of north, and in many cases, and perhaps in the majority of instances, the minor ranges have an axial trend about northwest and southeast. The consequence is, that all along the eastern side of the great range, the smaller ranges tend to die out in the plains. So that, to one traveling along the eastern base, the ends of these smaller ranges or ridges present a sort of "*en echelon*" appearance. This feature is much more clearly exposed on the Big Thompson Creek about forty miles north of Denver. Section 1, opposite page 20 in the annual report of the survey for 1873, illustrates the manner in which these ridges die out in the plains more clearly. Cheyenne Mountain, at *h*, is an example of a short mountain-range ending abruptly. There is still another point of interest which I believe to be capable of demonstration, though I have not accumulated a sufficient number of observations to express it with confidence. It seems to me that these great composite ranges of mountains have gradually grown to their present size by additions on either side; that, for instance, the single ridge appeared first, as a nucleus, and that, at different periods of time, minor ridges were elevated on either side of the main ridge. This seems to be quite evident, from the different mineral characters which compose the Pike's Peak group. This seems probable, also, from the fact that at one point the red beds, which are at least as old as the Jurassic, appear to have been deposited on the granites after they had been elevated nearly to their present position, while in many other instances the ridges have been lifted up after the deposition of the Lignitic strata. On the south side of the Fountain Creek, Mr. Holmes made some very interesting sketches and studies, which tended to show that these red beds were made up of materials taken from the granites in the immediate vicinity; that the red beds in immediate contact with the granites are made of rather large rounded granitic masses, cemented with sand, that the coarse conglomerate soon became a fine pudding-stone, and fine sandstones, as we gradually move eastward, from the base of the granitic ridge. It is possible that the great Rocky Mountain range was outlined in form, far back in the past, perhaps, even during the Carboniferous period, though it received vast additions during the Cretaceous and Tertiary epochs.

PLATE IX.

View of the Colorado or Front Range, taken from a point near Denver. The two profiles on this plate are continuous; the right-hand end of the upper one joining on to the left-hand end of the lower one.



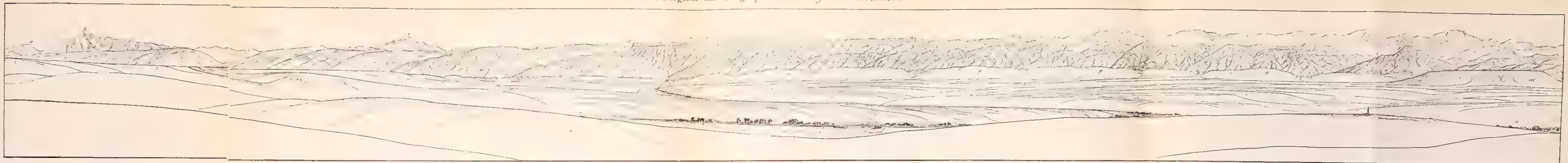
. *m*, *Green Mt.* *n*, *Denver*-5197.



p, *J.*

Arkansas Divide t, t.

U.S. Geological and Geographical Survey of the Territories



The GRANITES occupy all the dotted areas beyond the dotted line. This line follows the upturned edges of the sedimentary strata. CRETACEOUS rocks are exposed in the hogbacks ggg, as above, and ... behind these are the RED BEDS ... LIGNITIC strata and DRIFT cover nearly all the plain. VOLCANIC Rock caps the Table Mts & occurs at m on Green Mt at ... near Ralston's Creek and on the Arkansas Divide t.t.

THE FRONT OR COLORADO RANGE.

From near Denver

PLATE X.

View of the Pike's Peak Group, taken from bluff east of Monument Creek.

j. Castle Rocks. *x, M*

U.S. Geological and Geographical Survey of the Territories

a. Colorado Springs. b. Cheyenne Mt. c. Cheyenne Cañon. d. Bear Creek. e. Monte Rosa f. Red Beds. k.k. Mésa l. Camerons Cone. m. Garden of the Gods. n. Location of Manitou. o. Pike's Peak p.p. Austin's Bluffs. q. Ute Pass r. Queen's Cañon Glen Eyrie g. Lower Cretaceous t.t. Monument Cr u. West Monument Cr. v. Castle Rocks. x. Monument Park. y. Coal Series.

THE PIKE'S PEAK GROUP

From Bluff East of Monument Creek

THE TERTIARY PHYSOPODA OF COLORADO.

By Samuel H. Scudder.

Some years ago* I described a genus of fossil *Physopoda* from the North American Tertiaries. Since then I have found other species among the specimens collected by Prof. William Denton, and bring together in this place a connected account of all of them. They all belong to the *Terebrantia*. Species of *Physopoda* have been found in a fossil state in other places. Thus, Menge has described three species from the Prussian amber, and Oustalet, in a communication before the Société Philomathique of Paris (still I believe unpublished), gave the characters of several species from Aix, in Provence, in addition to the one long since described by Heer, from the same beds.

Melanothrips extincta, *nov. sp.*

Head small, tapering; the only appendages visible are the antennæ; these are only sufficiently preserved to recognize that they are very long and slender, longer than the thorax. The thorax is rather small, quadrate; wings nearly as long as the body, fringed on the costal border as in *Palæothrips fossilis*. The abdomen is composed of only eight joints, but is very long and very tapering, fusiform, the last joint produced, as usual in the physopods; the third joint is the broadest; of the wings only the costal border and a part of one of the longitudinal veins can be seen; there are no remains of legs. Length of body, $2^{mm}.2$; of antennæ, $0^{mm}.8.$; of head, $0^{mm}.14.$; of thorax, $0^{mm}.5.$; of abdomen, $1^{mm}.56$; greatest breadth of abdomen, $0^{mm}.5$. Chagrin Valley, Professor Denton.

LITHADOTHRIPS, *nov. gen.* (λιθάς, θρίψ).

Allied to *Melanothrips* Haliday. The head is large, broad, globose; the eyes exceedingly large, globose, each occupying, on a superior view, fully one-third of the head; the antennæ very slender, equal, as long as the thorax, the joints eight or nine in number, cylindrical, equal, scarcely enlarging toward their tips. The prothorax is no larger than the head, of equal breadth with it, the whole thorax shaped as in *Palæothrips*. Only fragments of the wings remain, sufficient to render it probable that they agree well with the character of the group to which *Melanothrips* and *Æolothrips* belong. The legs resemble those of *Palæothrips*, but are slender and appear to be rather profusely supplied with hairs. The abdomen differs considerably in the two specimens referred to this genus. In one it is very broadly fusiform, the tip a little produced, nine joints visible, the apical furnished with a few hairs, and bluntly rounded at the tip; the other has the sides equal, the apex not at all produced, but very broadly rounded, only seven or eight joints vaguely definable.

* Proc. Bost. Soc. Nat. Hist., xi, p. 117; Geol. Mag., v, p. 221.

LITHADOTHRIPS VETUSTA, *nov. sp.*

The specimens, both of which represent the upper surface of the body with fragments and vague impressions of the members, are too poorly preserved to add anything to the above description of their generic features excepting the following measurements: *First specimen:* length of body, $1^{mm}.76$; of antennæ, $0^{mm}.6$; of thorax, $0^{mm}.64$; of abdomen, $0^{mm}.87$; breadth of head, $0^{mm}.28$; of thorax, $0^{mm}.52$; of abdomen, $0^{mm}.56$; length of fore femora, $0^{mm}.37$?; breadth of same, $0^{mm}.14$; length of hind femora, $0^{mm}.42$; breadth of same, $0^{mm}.13$. *Second specimen:* length of body, $1^{mm}.96$; of antennæ, $0^{mm}.76$; of thorax, $0^{mm}.56$; of abdomen, $1^{mm}.10$; breadth of head, $0^{mm}.38$; of thorax, $0^{mm}.59$; of abdomen, $0^{mm}.59$. Fossil Cañon, Professor Denton.

PALÆOTHRIPS Scudder.

This genus, hitherto but briefly described, is allied to *Æolothrips* Haliday. The head is small, globose; eyes rounded, much smaller than in *Lithadothrips;* antennæ slender, fully as long as the thorax, not more than seven-jointed, the joints cylindrical, subequal. Prothorax considerably larger than the head, the thorax, as a whole, very large, stout, and tumid; fore femora very stout, scarcely more than twice as long as broad; fore tibiæ also stout, a little longer than the femora; the other legs are moderately stout, long, reaching beyond the tip of the abdomen, with a few scattered rather short spinous hairs; the hind tarsi three-jointed, the last joint smaller than the others and all together two-sevenths the length of the tibiæ. Fore wings unusually broad, broadest apically, where their breadth more than equals one-fourth of their entire length, provided with two longitudinal veins, dividing the disk into three nearly equal portions, connected in the middle by a cross-vein, and with either border by other cross-veins at about one-third and two-thirds the distance from the base to the tip of the wing; the wing is heavily fringed, especially along the hind border. Hind wings veinless, nearly as long, and, at the tip, nearly as broad as the fore wings. Abdomen nine-jointed, half as long again as the thorax, rather tumid, scarcely or not at all produced apically.

PALÆOTHRIPS FOSSILIS Scudd. (*loc. cit.*)

Head small, tapering a little in front, where, however, it is broadly rounded. The antennæ are certainly seven-jointed, and none of the apical joints show any indication of being connate, the last joint being of the same length as the two preceding it, tapering and bluntly pointed; none of the joints show any enlargement in the middle, but the middle joints are slightly larger at the distal extremity than at the base; they appear to be destitute of hairs. The prothorax is subquadrate, a little broader than long, with rounded sides; the fore femora are unusually stout, as long as the width of the prothorax. The longitudinal veins of the fore wings approach each other somewhat abruptly in the middle, where they are united by a cross-vein; and, at the tip of the wing, they curve away from each other; the two cross-veins on the lower third of the wing are, respectively, slightly further from the base of the wing than the corresponding veins of the upper third; the fringe on the posterior border is largest near the tip of the wing, where the hairs are about three times as long as those on the costal border. The first hind tarsal-joint is scarcely longer than broad, cylindrical; the second

of about the same length, but decidedly broader at apex than at base; the apical joint is nearly globular, smallest at base, as large in the middle as the base of the other joints. There are a few hairs at the tip of the abdomen, and a few short ones on the hind tibiæ; the apical ones stouter than the others, resembling spines; but the insect appears to have been unusually destitute of hairs, excepting on the wings, where not only the edges but also all the veins are fringed. Length of body, $1^{mm}.6$–$1^{mm}.8$; of antennæ, $0^{mm}.58$; of fore femora, $0^{mm}.32$; breadth of same, $0^{mm}.14$; length of fore tibiæ, $0^{mm}.32$; of hind femora, $0^{mm}.38$; breadth of same, $0^{mm}.11$; length of hind tibiæ, $0^{mm}.42$; of hind tarsi, $0^{mm}.12$; of fore wings, $1^{mm}.4$; of hind wings, $1^{mm}.27$; greatest breadth of fore wings, $0^{mm}.37$; length of prothorax, $0^{mm}.16$; breadth of same, $0^{mm}.32$; length of whole thorax, $0^{mm}.64$; of abdomen, $0^{mm}.92$; greatest breadth of the same, $0^{mm}.37$. Fossil Cañon, Professor Denton.

OUTLINES OF A NATURAL ARRANGEMENT OF THE FALCONIDÆ.

By Robert Ridgway.

[Read before the Philosophical Society of Washington, April, 1875.]

Until very recently, the Birds of Prey have been classified entirely according to their external characters, the primary division being into three so-called families, as follows: (1) *Vulturidæ*, or vultures, characterized by their naked heads, sluggish habits, and filthy food; (2) *Falconidæ*, or falcons, hawks, eagles, and other diurnal birds of prey, distinguished by their feathered head and predatory nature; and (3) *Strigidæ*, or owls, known from both the preceding by having the eyes directed forward, instead of laterally, and by being nocturnal.

Notwithstanding the fact that occasional genera constituted transitional forms intermediate between two "families",* the above classification was adopted almost universally until the year 1867, when Professor Huxley clearly demonstrated† that the so-called family *Vulturidæ* had no existence in fact. it being an unnatural association of members of two very distinct families, viz, the *Cathartidæ*, or American vultures, on the one hand, and a group of the *Falconidæ* (the Old-World vultures) on the other. Besides the announcement of the above important discovery, Professor Huxley also proved that the secretary bird (*Serpentarius reptilivorus*), previously included among the *Falconidæ*, was in reality the sole representative of a very distinct family, which he named "*Gypogeranidæ*."

To sum up the important results of Professor Huxley's studies of the osteology of the raptorial birds, they are briefly as follows: (1) The demolition of the old so-called family *Vulturidæ*, the typical members of which were referred to the *Falconidæ;* (2) the recognition of a separate family, *Cathartidæ*, to accommodate the aberrant ones; and (3) the removal of *Serpentarius* from the *Falconidæ* and its establishment as a distinct family, "*Gypogeranidæ*." The families of diurnal Raptores, according to Huxley's views, then were as follows: (1) *Cathartidæ* (American vultures); (2) *Gypaëtidæ* (=*Falconidæ*, hawks, &c., including the Old-World vultures); and (3) *Gypogeranidæ* (=*Serpentariidæ*, the secretary bird).

After a very careful consideration of all that relates to the principles of a natural classification, I find every reason for adopting, without hesitation, Mr. Huxley's conclusions.‡

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* Examples of these perplexing "intermediate" forms are the genera *Gypaëtus* and *Polyborus*, among the *Falconidæ*, which combine "vulturine" and "falconine" characteristics of habits and external appearance; while among the *Strigidæ* the genus *Surnia* is strictly diurnal, and its appearance decidedly hawk-like. The falconine genus *Circus*, on the other hand, has a distinct facial ruff and other characteristics belonging chiefly to the owls. These cases were very embarrassing to the followers of the old classification, and by different authors were shifted from one family to the other.

† Proceedings of the Zoölogical Society of London, 1867, pp. 440, 443, 462, 465.

‡ I cannot follow, however, in substituting the name *Gypaëtidæ* for the old term *Falconidæ*, which in its former signification is sufficiently comprehensive to justify its continued use as the proper name for this family; the term *Gypogeranidæ* is equally objectionable, since *Gypogeranus* (Illiger, 1811) is antedated by *Serpentarius* (Cuvier, 1798), in consequence of which *Serpentariidæ* (Selys, 1842), as adopted by Gray (Hand List, 1869, p. 38), is preferable.

A fifth family, the *Cariamidæ*, or Cariamas, is quite nearly related to those mentioned, and has by some authors been even included among the *Falconidæ;* but the degree of its relationship by no means justifies that view of its affinity. The families *Strigidæ*, *Falconidæ*, *Cathartidæ*, *Serpentariidæ*, and *Cariamidæ* may possibly be eventually combined to form an order; but whether this association would be a natural one is an undecided question, beyond the province of this paper.

Having defined the limits of the family *Falconidæ*, it now remains to treat of this alone; the subdivisions of the family being the subject of discussion.

To the present time, the *Falconidæ* have been divided into a greater or less number of so-called "subfamilies", the number varying according to the author; those founding their classification on purely external characters finding it necessary to adopt a great many, and those relying upon the anatomical characters carefully avoiding any subdivision at all.*

To review in this connection all the classifications of the family which have been proposed up to the present time would require far more space than the limits of this memoir will allow; each author, while following a generally-recognized plan, having his own peculiar views regarding certain details of arrangement. It will, therefore, suffice for the present to give a mere outline of this generally-adopted plan, and supplement it by the modified systems of our latest and best authorities.

The "subfamilies" usually recognized are the following: (1) "*Falconinæ*", (2) "*Milvinæ*", (3) "*Accipitrinæ*", (4) "*Circinæ*", (5) "*Buteoninæ*", (6) "*Aquilinæ*", and (7) "*Polyborinæ.*" Some authors add "*Circætinæ*" and "*Pandioninæ*"*;* while previous to the important discovery, made by Professor Huxley, regarding the vultures before alluded to, this supposed family was divided into the so-called subfamilies, (1) "*Vulturinæ*", (2) "*Gypinæ*", (3) "*Neophroninæ*", (4) "*Gypaëtinæ*", and (5) "*Gypohieracinæ*",—some authors grouping two or more of these in one, others recognizing all. They are all, of course, typical *Falconidæ*, thus making a total of fourteen subfamilies into which this family has been divided, when there are in reality but two.

Mr. George Robert Gray, in his "Hand List of Birds in the British Museum",† divides the *Falconidæ* into seven so-called subfamilies, as follows: (1) *Polyborinæ*, LAFR., 1839 (=*Polybori* of the subfamily *Falconinæ*); (2) "*Buteoninæ*, SWAINS., 1837"; (3) "*Aquilinæ*, SWAINS., 1837"; (including *Pandion*!); (4) "*Falconinæ*, SWAINS., 1837" (including *Harpagus*!); (5) "*Milvinæ*, BONAP., 1838"; (6) "*Accipitrinæ*, SWAINS., 1837" (including *Herpetotheres* and *Micrastur*, both groups of the subfamily *Falconidæ*) and (7) "*Circinæ*, BP."

Messrs. Philip Lutley Sclater and Osbert Salvin, in their "*Nomenclator Avium Neotropicalium*",‡ divide the American members of the family into the following "subfamilies": (1) "*Pandioninæ*", (2) "*Circinæ*", (3) "*Buteoninæ*", (4) "*Accipitrinæ*", (5) "*Falconinæ*," (6) "*Milvinæ*", (7) "*Herpetotherinæ*", and (8) "*Polyborinæ.*"

Mr. R. Bowdler Sharpe, in his recently-published great-work upon the diurnal "*Accipitres*",§ employs a singularly inconsistent classification,

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*This has, perhaps, been mainly due, not to the difficulty of finding sufficiently good characters, but to the fact that the conclusions arrived at were so opposed to views long established by usage.

†London, 1869, (vol. I).

‡ London, 1873, pp. 118–123.

§ Catalogue of the *Accipitres*, or diurnal birds of prey, in the collection of the British Museum. London, July, 1874.

which can only be considered a decided retrograde from, instead of an improvement upon, the better classifications which preceded it. In the first place, the genus *Pandion* is made to form a "suborder"—*Pandiones!* This would not be so bad, all things considered, were it not that the genus *Polioaëtus* is included in this so-called "suborder", the latter being a very near relative, probably a subgenus, of *Haliaëtus*, one of the group *Buteones* of the subfamily *Buteoninæ*, and not at all allied to *Pandion* (group *Pandiones* of *Buteoninæ*), though it represents that genus in its group; that is, is analogous, but not affined to it. In the next place, *Serpentarius* (= family *Serpentariidæ*) and *Cariama* (= family *Cariamidæ*) are placed in the "subfamily" *Polyborinæ!* The subfamilies which Mr. Sharpe recognizes are the following: (1) *Polyborinæ*, (2) *Accipitrinæ*, (3) *Buteoninæ*, (4) *Aquilinæ*, and (5) *Falconinæ*.

In this connection, it may be well to call attention to the importance of distinguishing between evidences of affinity and those of mere analogy in the birds of this family. Certain types of teleological modifications are repeated in members of different subfamilies, and in different groups of one subfamily, to such a degree of perfection, that, if we were to follow external appearance only, we would not hesitate to place them near together in a systematic arrangement. This is what has led to such confusion and such utterly unsatisfactory results as have characterized most attempts at a natural classification. Among the more prominent instances of analogy between members of different groups or subfamilies, or even different families, the following may be mentioned: The family *Cathartidæ* is reproduced in the vultures of the Old World (vulturine series, group *Buteones*, subfamily *Buteoninæ*, family *Falconidæ*); the *Gypogeranidæ* and *Cariamidæ*, in a less degree, by *Polyboroides* and *Geranospizias* (*Buteones*); the *Strigidæ*, in a very slight degree, by *Circus* (*Buteones*, *Buteoninæ*), *Micrastur* (*Micrastures*, *Falconinæ*), and *Pandion* (*Pandiones*, *Buteoninæ*).* The *Falcones* are represented in the *Buteoninæ* by *Ictinia* and *Harpagus* (*Buteones*); also by *Baza* (*Pernes*); one of the *Polybori* (*Ibycter*) by *Rostrhamus* (*Buteones*); the *Micrastures* are repeated in the genera *Circus* and *Nisus* † (*Buteones*), and *Herpetotheres* very nearly imitated by *Circaëtus* (*Buteones*). Taking the *Buteoninæ* alone, the *Pandiones* are mimicked by certain *Haliaëti* (*Buteones*); Certain *Pernes* (*Elanoides*) by *Milvus* and *Nauclerus* (*Buteones*); and others of the same group (*Baza* and *Aviceda*) by *Harpagus* and *Ictinia*.

In three widely-distinct "series" of genera in the group *Buteones*, we find a very peculiar type of modification, viz, the excessive abbreviation of the outer toe. This occurs only in *Heteropus* (an "aquiline" form, with densely-feathered tarsus), *Polyboroides* (a long-legged terrestrial form, with reticulated tarsus), and *Geranorpozias* (similar to the last, but with scutelate tarsus); these latter two differ from the first in being of terrestrial habits, and in a very remarkable teleological modification of the tibio-tarsal joint, whereby it can be bent with ease *in both directions*.

The following tabular arrangement expresses the equivalents of the two subfamilies and several groups, adopted in this memoir in the numerous "subfamilies," or "families" of leading authorities, and suc-

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* *Circus* resembles the owls merely in the possession of a distinct facial ruff and large ear-aperture; *Micrastur*, in the same respects, and also in decomposed downy edges to the inner webs of the primaries, the rounded, concave wing, as well as in the dimorphic plumage of some of the species ("rufescent" and "gray" "phases"); *Pandion*, in having the outer toe reversible and in lacking after-shafts to the feathers.

† In general form, *Micrastur* exactly repeats the genus *Nisus*, and has, besides, the facial ruff of the genus *Circus*.

ceeding it a series of diagnoses explaining the reasons which justify such a classification :*

Subfamilies—present arrangement.	RIDGWAY. ("*Groups.*")	SHARPE. ("*Subfamilies.*")	SCL. & SALV. ("*Subfamilies.*")	SUNDEVALL [1] ("*Families.*")
Falconinæ.	Falcones.	Falconinæ.	Falconinæ.	Falconinæ.
	Polybori.	Polyborinæ.	Polyborinæ.	Polyborinæ.
	Micrastures.	Accipitrinæ (pt.).	Accipitrinæ (pt.).	Circaëtinæ (pt.).
	Herpetotheres.	Aquilinæ (pt.).	Herpetotherinæ.	Circaëtinæ (pt.).
Buteoninæ.	Pandiones.	Pandiones.[2]	Pandioninæ.	Circaëtinæ (pt.).
	Pernes.	Aquilinæ (pt.), Falconinæ (pt.), Milvinæ (pt.).	Milvinæ (pt.).	Circaëtinæ (pt.).
	Buteones.	Accipitrinæ (pt.), Buteoninæ (pt.), Aquilinæ (pt.), Falconinæ (pt.), Vulturidæ (pt.).	Falconinæ (pt.), Milvinæ (pt.), Circinæ, Accipitrinæ (pt.).	Falconinæ (pt.), Circaëtinæ (pt.), Aquilinæ (pt.), Gypaëtinæ, Vulturinæ, Haliaëtinæ (pt.).

[1] Förnyad anordning av Dagrovfoglarna (Dispositio nova Accipitrum Hemeroharpagorum). Öfersigt af Kongl. Vetenskaps Akademiens Fordhandlingar 1874. No. 2. Stockholm.
[2] "Suborder."

A.—Scapular process of the coracoid produced forward so as to meet the clavicle.† Nasal bones almost completely ossified, the nostril being a small, usually circular, opening, with a conspicuous, usually central, bony tubercle.‡ Inferior surface of the supramaxillary with a prominent median angular ridge. Superciliary process of the lachrymal consisting of a single piece.§ .... Subfamily *Falconinæ*.

B.—Scapular process of the coracoid *not* produced forward, but separated from the clavicle by a wide interval.|| Nasal bones very incompletely ossified, the nostrils large, without bony tubercle, and frequently with an incomplete septum. Inferior surface of the supramaxillary without median ridge.¶ Superciliary process of the lachrymal usually consisting of two pieces, joined by a cartilaginous hinge.** .... Subfamily *Buteoninæ*.

* It is proper to explain here that the key to the leading character was furnished by Professor Huxley in the paper before referred to (p. 464), in the following words : "The scapular process of the coracoid sometimes is * [* *e. g.*, in the Falcons proper, and in *Polyborus*] and sometimes is not produced to the clavicle"—having reference to the family *Falconidæ*. Following up this clew by examining the coracoid apparatus of every genus available, I was surprised to find it to be a character which separated trenchantly not only the "Falcons proper" (=*Falcones*) and *Polyborus*, but also all the genera related to the latter, besides *Micrastur* and *Herpetotheres*, from all other *Falconidæ*.

† See Plate XI, Figs. 1–4.

‡ Except in *Micrastur*. (See Plate XII, Fig. 4.)

§ See Plate XIII, Figs. 1–4.

|| See Plate XI, Figs. 5–11.

¶ In Fig. 6, Plate XII, the tomium of the supramaxillary is so deeply sinuated as to allow the middle portion of the under surface to be seen from the side ; but this has no analogy to the *raised* median ridge of the falconine forms.

** The exceptions are the *Pandiones* (*Pandion*) and *Pernes* (*Elanoides*, *Cymindis*, *Regerhinus*, *Aviceda*, *Baza*, &c.), in which this bone much resembles that of the *Polybori*, as shown in Figs. 6 and 7, Plate XIII.

Subfamily FALCONINÆ.

The term *Falconinæ* has been restricted in most previous arrangements to the true falcons (=*Falcones* of the present system), but in view of its being a subfamily-name it becomes necessary to make it cover all the forms allied to these by subfamily-characters; hence the wider signification given it here.

The subfamily *Falconinæ* is composed of four well-defined groups, the *Falcones*, *Polybori*, *Micrastures*, and *Herpetotheres*, which are distinguished as follows:

A.—Posterior toe abbreviated, very much shorter than the lateral pair; tarsi and toes covered with small hexagonal scales, larger in front.

a. Nostril a small, round, or oblique opening, with a bony rimmed margin and central tubercle. (Plate XII, Figs. 1–3.)

1. Superior tomium with a conspicuous tooth, and inferior tomium with a corresponding notch. (Plate XII, Fig. 2, and Plate XV, Fig. 1.) Superciliary process of the lachrymal elongated, narrow, reaching nearly across the orbit. (Pl. XIII, Fig. 2.) Posterior margin of the sternum nearly even, with a pair of large oval foramina. One or two outer primaries with their inner webs emarginated near their tips. (Plate XVII, Figs. 1 and 2.)..Group 1, *Falcones*.

2. Tomia without tooth or notch.*
Superciliary process of the lachrymal abbreviated, reaching only half-way across the orbit. (Plate XIII, Fig. 1.) Posterior margin of the sternum with a pair of deep indentations. Three or more outer primaries with their inner webs sinuated near the middle portion. (Plate XVII, Figs. 3 and 4.)........................ Group 2, *Polybori*.

b. Nostril a large opening without bony-rimmed margin or central tubercle. (Plate XII, Fig. 4.)

3. Superciliary process of the lachrymal elongated, broad, extending nearly across the orbit. (Plate XIII, Fig. 4.) Tomia without tooth or notch. (Plate XII, Fig. 4, and Plate XIV, Fig. 2.) Posterior margin of the sternum as in *Falcones*. Four or more outer primaries with inner webs sinuated near the middle portion...Group 3, *Micrastures*.

B.—Posterior toe elongated, almost equal to the lateral pair. Tarsi and toes covered uniformly with thin, rough, imbricated scales.

4. Tomia without tooth or notch. (Plate XII, Fig. 3, and Plate XIV, Fig. 1.) Nostril as in *Falcones* and *Polybori*. Superciliary process of the lachrymal elongated, very broad, reaching nearly across the orbit. (Plate XIII, Fig. 3.) Posterior margin of the sternum nearly even, entire, and without foramina. Primaries as in *Polybori* and *Micrastures* ....Group 4, *Herpetotheres*.

The pterylography of the members of this subfamily affords some very important diagnostic characters. From the descriptions given by Nitzsch† (pp. 55–57), the following arrangement may be tabulated,

* Though faint indications of these are observable in some genera (*Milvago* and *Phalcobænas* (see Plate XV, Fig. 2) in the horny sheath, they cannot be detected in the bone of the bill. (See Plate XII, Fig. 1.)

† Nitzsch's Pterylography, translated from the German, edited by Philip Lutley Sclater, M. A., Ph. D., F. R. S., secretary to the Zoölogical Society of London. London: Published for the Ray Society, by Robert Hardwicke, 192 Piccadilly. 1867. pp. 118, ppl. 10.

which, in the main, supports the one founded on the osteological structure.

A.—Dorsal portion of the spinal tract deeply divided, and each branch dilated exteriorly .... *Falcones*

B.—Dorsal portion of the spinal tract enlarged on all sides, undivided, and sparsely feathered.

a.—Eyelids with distinct lashes; lumbar tract present; dorsal portion of the spinal tract sparsely feathered to the caudal pit, thence diminished and continued as a narrow band along the caudal vertebræ to the oil-gland ....*Herpetotheres.*

b.—Eyelids without distinct lashes; lumbar tract absent; dorsal portion of the spinal tract in the form of an elongated ellipse, only contracted into a band immediately in front of the oil-gland (but even there still broad), consisting exclusively of scattered feathers, which become stronger posteriorly. *Micrastures.*

The only close relationship between any two groups of this subfamily is seen in the generalized forms of the *Falcones* and *Polybori* (*Hieracidea* and *Milvago*), whose specialized forms (*Falco* and *Polyborus*) are so extremely dissimilar in appearance. In the two genera mentioned, the approach is so very close as to almost form a transition between the two groups.* There is a wonderful similarity in the general form and relative proportions of all the parts, the arrangement of the scutellæ of the tarsi and toes, the character of the plumage, and the size of the species. But notwithstanding this apparent correspondence of external characters, they are found to differ in all those osteological characters diagnostic of their respective groups, and, when their external structure is examined closely, agree severally with the other members of the groups to which they belong in an apparently trivial yet really pertinent character, viz, *the cutting of the inner webs of the outer primaries*, which is always essentially different in the two groups. The external diagnostic characters (associated with osteological, indicated on p. 229) are thus reduced to the structure of the primaries, as follows:

FALCONES.—Two, or less, outer primaries with their inner webs cut; this always an abrupt emargination on the first, and situated near its end. Second or third quill longest; first longer than the fifth.

POLYBORI.—Three, or more, outer primaries with their inner webs cut; this an oblique sinuation on the first, and near its middle. Third or fourth quill longest; first shorter than the fifth.

The *Falcones* comprise very few genera in proportion to the number of species, which is very considerable; but it is outside the purpose of this paper to discuss the subject of what the genera of the group are. Suffice it to say that neither *Baza* nor *Harpagus* belong here, as many have supposed, being members of different groups (*Pernes* and *Ictiniæ*) of the subfamily *Buteoninæ*. The genus *Spiziapteryx*, however, which many consider a synonym of *Harpagus*, is a true Falcon.

The groups *Micrastures* and *Herpetotheres* have but one genus each, so these are passed by without further notice; but the Polyborine genera are numerous, and, as they have never been satisfactorily defined, the following diagnoses are presented:

* The typical *Hieracideæ* will, upon examination, probably be found to have the superciliary process of the lachrymal much shorter than that of the typical *Falcones*, if it does not approach the extreme brevity of this bone which characterizes the Polyborine group.

Genera and subgenera of POLYBORI.

A.—Tarsus $\frac{1}{2}$–$\frac{2}{3}$ its length longer than the middle toe; outer toe but little longer than the inner; posterior toe very decidedly shorter than the inner; claws slightly curved, blunt. Inner webs of primaries deeply sinuated. Habits chiefly terrestrial.

a. Nostril linear, obliquely vertical, its tubercle concealed.

1. POLYBORUS. Nostril linear, obliquely vertical, its posterior end the upper one;* situated in the upper anterior corner of the cere. Anterior outline of the cere nearly straight and vertical. Occipital feathers elongated into a depressed crest.

b. Nostril circular, in the middle of the cere, its tubercle exposed;† anterior outline of the cere doubly curved.

2. PHALCOBÆNUS. Tooth and notch of the tomia of the bill nearly obsolete; lower jaw nearly naked; outer toe not appreciably longer than the inner; posterior toe reaching much beyond the first joint of the middle toe; claws remarkably blunt, slightly curved; posterior face of the tarsus without distinct rows of quadrate scales; upper tail-coverts remarkably developed, covering nearly two-thirds the tail; size large.

α. Frontal feathers (of adult) recurved, very soft, lanceolate; loral and maxillary regions naked; fore-neck feathered. In the adult, the abdomen, anal region, crissum, upper tail-coverts, and lining of the wing white; secondaries and tail tipped with white; other parts deep black . . *Phalcobænus.*

β. Frontal feathers pointed backward (normally), stiff and lanceolate; lower jaw and lores densely covered with strong bristles; fore-neck naked. In the adult, abdomen and anal-region ochraceous; crissum and upper tail-coverts black; lining of the wing and tibiæ black mixed with ochraceous; breast and nape longitudinally streaked with dingy whitish; secondaries not tipped with white . . . . *Senex.*

3. MILVAGO. Tooth and notch of the tomia of the bill distinctly indicated; lower jaw normally feathered; outer toe decidedly longer than the inner; posterior toe not reaching the first joint of the middle toe; claws sharp, strongly curved (as in the *Falcones*); posterior face of the tarsus with two distinct rows of quadrate scales. Upper tail-coverts normal, covering about one-third the tail; size small.

B.—Tarsus scarcely longer than the middle toe; outer toe very much longer than the inner, which is but little longer than the posterior one. Inner webs of primaries shallowly sinuated. Habits strictly arboreal.

4. IBYCTER. Nostril circular, near the middle of the cere, its tubercle either concealed or exposed; anterior outline of the cere doubly curved. Tarsus without transverse scutellæ either in front or behind.

α. Size large. Bill slender, the tip much produced; gonys barely convex, nearly horizontal. Bare superciliary region very narrow. (See Plate XVIII, Fig. 1.) . . *Ibycter.*

β. Size small. Bill thick, the tip only slightly produced; gonys strongly convex, decidedly ascending terminally. Bare superciliary region very wide. (See Plate XVIII, Fig. 2.) . . . . *Daptrius.*

---

* This is exactly the reverse of the position of the nostril in all other *Falconidæ*, in which its direction is oblique! †As in the Falcones!

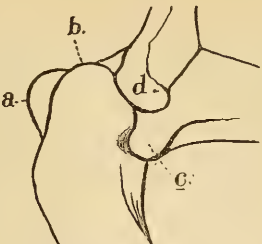
PLATE XI.

CORACOID APPARATUS.

(*All natural size.*)

Fig. 1. Falco anatum.
2. Ibycter americanus.
3. Micrastur semitorquatus.
4. Herpetotheres cachinnans.
5. Pandion carolinensis.
6. Elanoides forficatus.
7. Elanus leucurus.
8. Ictinia mississippiensis.
9. Rostrhamus sociabilis.
10. Buteo borealis.
11. Aquila canadensis.

[*a*. Anterior process of the coracoid.
b. Basal process of the scapula.
c. Scapular process of the coracoid.]



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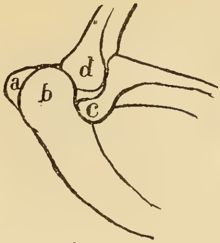

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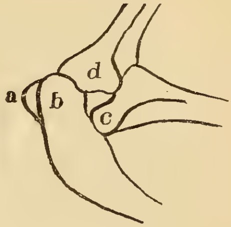

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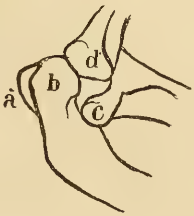

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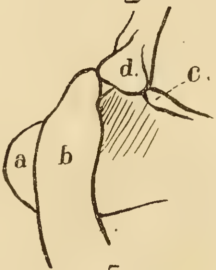

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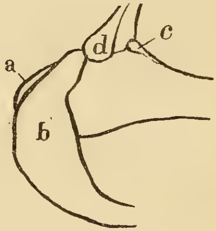

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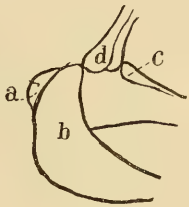

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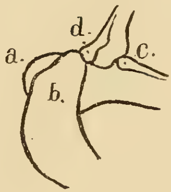

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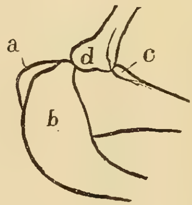

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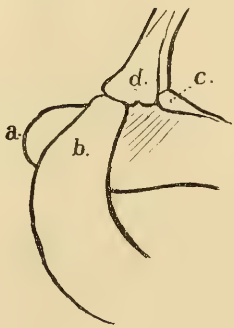

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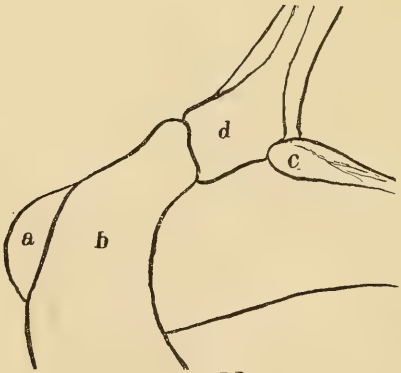

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PLATE XII.

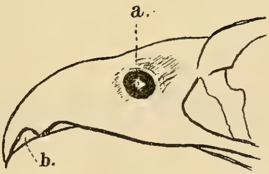
SUPRAMAXILLARY AND NASAL BONES.

(*Natural size.*)

FIG. 1. Phalcobænus australis.
2. Falco anatum.
3. Herpetotheres cachinnans.
4. Micrastur semitorquatus.
5. Pandion carolinensis.
6. Ictinia mississippiensis.
7. Antenor harrisi.
8. Harpagus bidentatus.

[*a*. Bony tubercle of the nostril.
b. Median ridge of the supramaxillary.]

1



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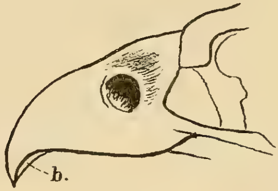

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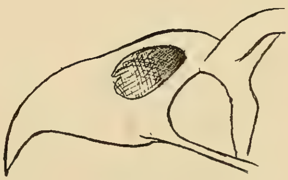

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PLATE XIII.

SUPERCILIARY PROCESS OF THE LACHRYMAL.

(*Natural size.*)

FIG. 1. Phalcobænus australis.
2. Falco anatum.
3. Herpetotheres cachinnans.
4. Micrastur semitorquatus.
5. Antenor harrisi.
6. Pandion carolinensis.
7. Elanoides forficatus.
8. Harpagus bidentatus.

[*a.* Superciliary process of the lachrymal.
b. Accessory piece.]

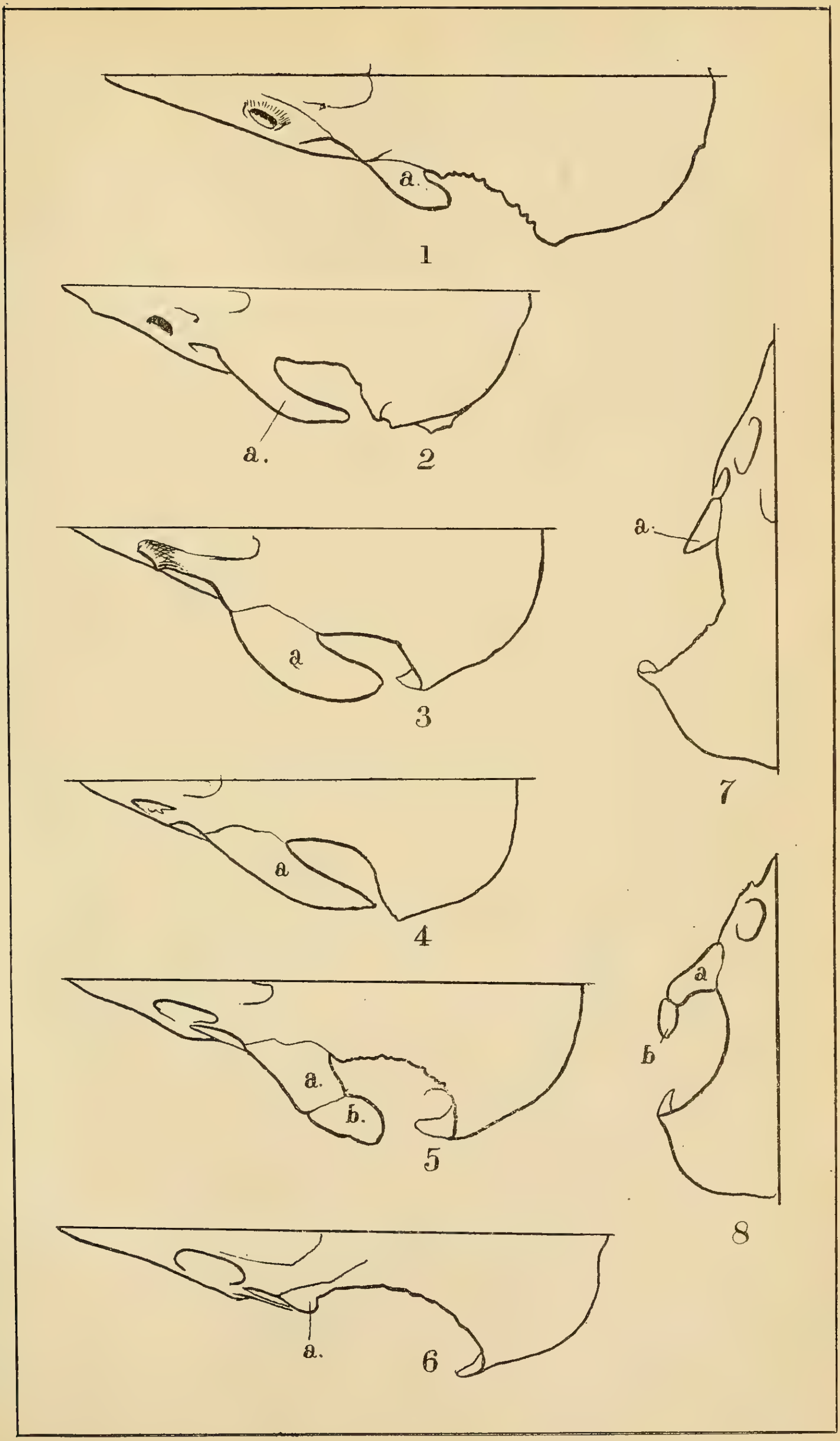

a.
1
a.
2
a
3
a
4
a.
b.
5
a.
6
a.
7
a
b
8

PLATE XIV.

(*Natural size.*)

FIG. 1. Herpetotheres cachinnans.
2. Micrastur semitorquatus.

1

2

PLATE XV.

(Natural size.)

Fig. 1. Hieracidea berigora.
2. Milvago chimango.

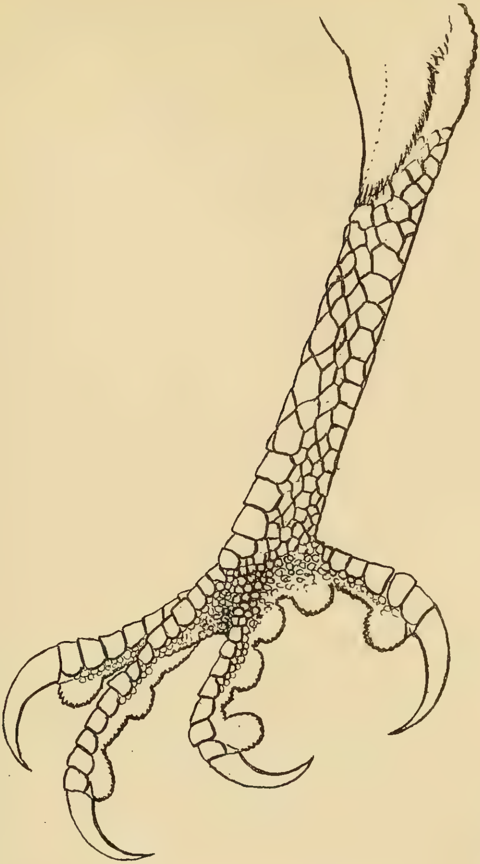
1

2

PLATE XVI.

(*Natural size.*)

FIG. 1. Hieracidea berigora.
2. Milvago chimango.



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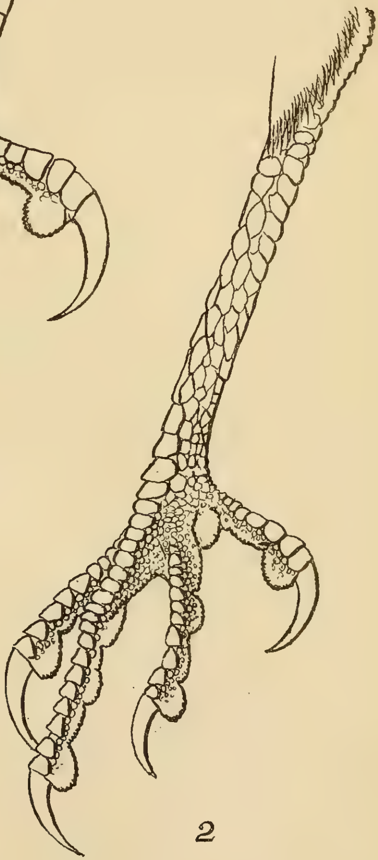

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PLATE XVII.

(*One-half natural size.*)

FIG. 1. Falco aurantius.

2. Hieracidea berigora.
3. Milvago chimango.
4. Phalcobænus megalopterus.

1

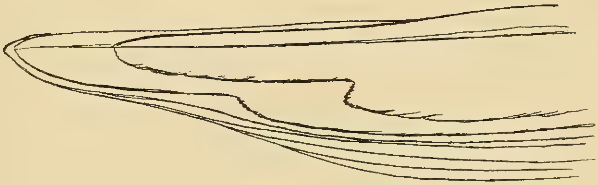

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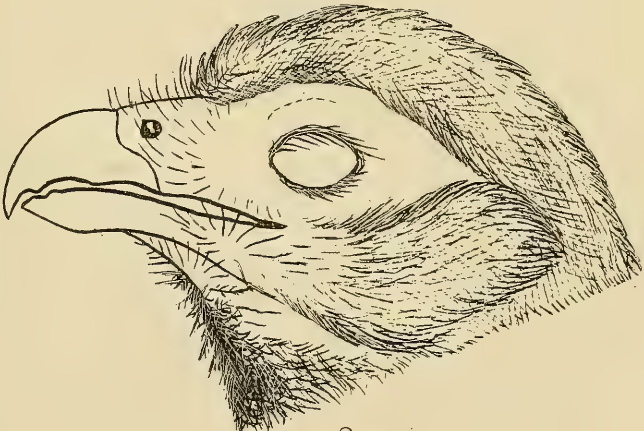
PLATE XVIII.

(*Natural size.*)

FIG. 1. Ibycter americanus.
2. Ibycter (Daptrius) ater.

1



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DEPARTMENT OF THE INTERIOR.

BULLETIN

OF

THE UNITED STATES

GEOLOGICAL AND GEOGRAPHICAL SURVEY

OF

THE TERRITORIES.

BULLETIN, NO. 5.—SECOND SERIES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
January 8, 1876.

DEPARTMENT OF THE INTERIOR.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

BULLETIN NO. 5.—SECOND SERIES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1876.

A REVIEW OF THE FOSSIL FLORA OF NORTH AMERICA.*

BY LEO LESQUEREUX.

For years, the explorations of Dr. F. V. Hayden in the Rocky Mountain regions, pursued under the direction of the Department of the Interior, have awakened a deep and general interest by the remarkable natural phenomena which they have brought to light. Not only have these explorations penetrated into unknown regions, tracing out broad areas, the existence of which was not fully realized, and the discovery of which has been recorded as of as great moment as any of those made at our time: not only have they reported great valleys in the midde of the mountains; parks prepared by their fertility for a future population; rich mining-districts abounding in precious minerals; wonders of nature also, like the Geysers of the Yellowstone, rivaling in splendor the greatest marvels of the world: but they have opened to science new fields of researches, where American naturalists have found treasures of fossil remains, a world of unknown species of animals and plants, which enrich beyond expectation the annals of science of this country. The discoveries of remains of huge saurians and of mammifers, of deposits of rocks composed of shells of remarkable kinds, have been already recorded at different times, and even telegraphed through the country on account of their importance.

The great Lignitic coal-fields also, extending along the base of the Rocky Mountains in the whole width of the United States Territories, from New Mexico to Oregon, were scarcely known before the explorations of Dr. Hayden, who defined their outlines and areas, and recorded the multiplicity and richness of their deposits of coal. The Lignitic is for the West what the great Appalachian coal-region is for the East, but more valuable still, perhaps, for the commonwealth, as without these deposits of combustible mineral the Rocky Mountain regions, and the great western plains at their base, would be uninhabitable.

A special branch of the researches pursued by Dr. Hayden's explorations relates to vegetable paleontology. Collections of fossil plants have been extensively made under his direction, especially with reference to the determination of the geological age of the Lignitic formations and of the Cretaceous Dakota group of Kansas. It is on this subject of vegetable paleontology that this article is written. I do not propose, however, to give herewith a description, nor even an enumeration, of the species of fossil plants which were discovered by Dr. Hayden; but to go through an abridged review of what is known as yet of the North American fossil flora, marking some of its essential characters at different periods, pointing out some of the results that have been already obtained by the application of vegetable paleontology to physical and geological science, and what we may expect from it when the field, scarcely opened, is explored with more interest and more exhaustive researches.

A brief history of our North American flora, in regard to the origin

* This article was originally prepared, at my request, for the Penn Monthly, at Philadelphia. So much value has been attached to the essay that it seemed to me desirable that it should have a wider circulation among scientific men. I therefore requested the author to revise it for the Bulletin, and it is here reprinted with many important additions. F. V. H.

of some of our more valuable and generally-known species of trees, and to the preponderance and the facies of their families at different times, may prove of general interest, and be the more acceptable, as it does not require for its comprehension any peculiar acquaintance with botanical science. The few details necessary for the understanding of the whole may be explained in a few words.

The great primary divisions of the vegetable kingdom, as they are generally admitted now, are: 1st. The *Thallogens*, plants with mere cellular tissue, like the Algæ or Sea-Weeds, the Lichens, the Fungi. 2d. The *Acrogens*, flowerless plants, like the former, but composed of a woody tissue and of vessels. To this class belong the Ferns, known by everybody; the Lycopods or Club-Mosses, the Equiseta, generally named Horsetail. 3d. The Gymnosperms, or Cone-bearing plants, like the *Conifers* and the *Cycadeæ*. 4th. The *Endogens*, or Monocotyledonous plants, which grow and increase from the inside, like the Palms, the Grasses, the Lilies, etc. 5th. The *Exogens*, or *Dicotyledons*, whose representatives mostly compose our present arborescent vegetation.

In regard to their character, these classes are generally admitted as of a gradually more complex and complete organization in ascending from the lowest division, the Thallogen; and it is also a well-established opinion that, in the geological succession of their representatives, the plants of the lowest order appeared first, and were followed by species of the other divisions, in the succession indicated above. The facts, however, in support of this assertion are not yet sufficiently ascertained.

The original or first crust of the earth's surface is composed of crystalline rocks, metamorphic or changed by fire, where no forms of organized bodies can be recognized. Vegetable life, however, seems manifested in these primitive rocks by deposits of graphite, a metamorphic carbonaceous substance, whose origin, like that of all the other combustible minerals of this world, is attributable to the plants, and to animals also, of which carbon is a compound. The Algæ of the simplest structure consist of single isolated cells; like the *Diatomaceæ* and *Desmidaceæ*, which are the smallest vegetables known, and which, simple as they are, represent, however, most beautiful and innumerable forms, appreciable only by microscopical investigation. These kinds of Algæ live everywhere, in the hottest springs and the snow of the glaciers, on sand or mud, on every kind of substance; they multiply rapidly and in enormous proportions. In some localities, the water of the sea is colored to a depth of many feet, and over a surface of wide extent, by the presence of the *Diatomaceæ;* plants so minute in size that a million of them may live in a drop of water. The peculiar nature of these unicellular plants confirms the idea that they have appeared with the first consolidated strata of the globe.

To their life, therefore, the origin of the deposits of bitumen or carbon, as represented by graphite in the primitive rocks, is probably due. The temperature of these rocks, originally in a state of fusion, has been considered as an objection to this opinion. But even at the present epoch, Algæ, of a higher degree of organism, fill, by their thread-like filaments, basins of thermal water whose temperature reaches 100° C., as in the Hot Springs of Arkansas or in the Geysers of the Yellowstone.

Immediately above the crystalline rocks, and from the beginning of the stratified deposits of the Lower Silurian, whose substance has been derived from the disintegration and the removal of primitive materials, vegetable fossil remains are recognizable.

They represent marine plants, of course, mostly of indefinite forms, like crushed bundles of filaments, whose contours are obliterated in a

black carbonaceous or bituminous mass. In passing higher up, in beds of the same period, the forms become more distinct and less disfigured by compression, but mostly remain simple, however, like narrow, cylindrical, rigid, or flexuous stems, without branches and with smooth surfaces. These characters seem to indicate a simple structure of the Algæ by juxtaposition of elongated cells joined by their ends, as are now the thread-like filaments of the thermal springs. In ascending still higher —to the Upper Silurian—these fucoids appear more diversified: they bear branches; their surface is wrinkled or striated in many ways; and their characters being thus more distinct and multiplied, they are open to analysis and to classification. Already a number of them have been described from these strata. At the same time, the fossil remains increase in number to such a degree that strata of shale or of limestone seem, locally, to be a compound of fragments of sea-weeds. As these petrified plants apparently represent only the easily-preserved species, those of a coriaceous hard tissue, the profusion of their remains may give an idea of the exuberance of the marine flora during the more ancient periods of our earth. It was evidently still greater than at the present time, though the activity of this vegetation is now manifested to a high degree by the heaps of the bladder-weed and other species along our shores, as also in mid-ocean by banks of the floating *Sargassum*, covering thousands of square miles, and thick enough to impede or almost stop the progress of ships. The fucoids of old, some of which were ot great size, though composed only of vascular tissue and without woody fibers, *foreshadowed* the appearance of the coal-plants, to which they already did play in the economy of nature a somewhat analogous part. From their decomposition have resulted the deposits of bitumen, or mineral oil, which man's ingenuity uses now to an advantage not equal indeed, but comparable, to that which he derives from the coal.

The remains of sea-weeds do not give any indication of the temperature or the atmospheric circumstances governing our globe during that long Silurian period when water covered most of the surface of the earth, either in a condensed form as fluid, or as vapor. The temperature of the sea was of a higher degree, evidently, than it is at the present time even under the influence of tropical heat. The simple structure of the sea-weeds and their cylindrical form seem to indicate this physical fact by the coincidence, remarked above, of confervoid plants of simple and analogous conformation found now in the hottest thermal water. In the whole thickness of the rocks formed during this long period, which in some countries, as in England, attain a thickness of 60,000 feet, no traces of land-plants had been previously observed. A few cylindrical branches, or impressions of branches upon clay, bearing upon their surface rhomboidal scars disposed in spirals around the stem like those of *Lepidodendron*, were lately discovered in the Cincinnati group of the Middle Silurian. As they were found associated in the same strata with fragments of fucoids and deep marine mollusks, their relation was considered as being rather with peculiar forms of Algæ. More recently, however, fossil remains of two species of vegetables, positively recognized as land-plants, have been found in the Silurian formation of the Lower Helderberg of Michigan, and attest the existence of land plants, and, consequently, animal life also, in the Silurian period, a fact which till now had remained uncertain. The presence of land-plants in strata of a lower formation—that of the Cincinnati group—becomes less improbable by this discovery.

In the whole thickness of the following period, the Devonian, the marine vegetation is still predominant, as testified by fucoidal remains

profusely imbedded in the rocks, and by the most numerous and richest deposits of bitumen discovered, as yet, by human agency. The forms recognized in the fossil remains indicate a more diversified kind of vegetation, and a more complex and more perfect structure. Some of them have already characters which seem identical with those of more recent fossil species, and even closely allied to some of our time. This correlation is explainable in two ways: First, in supposing that, as vegetables have characters in accordance with the surroundings wherein they live, marine plants vary especially according to depth and pressure, to the temperature of the water, and also to its proportion of saline or other mineral elements. All these agents are not subject to modifications either as distinct or as rapid as those which govern the atmosphere, and therefore the types of the Algæ are preserved for a longer time less diversified and more widely distributed than those of the land-plants. On another side, the difficulty of exact determination of fossil Algæ may be taken into account for explaining the cases of identity as merely apparent, the more important characters of those plants being more or less undiscernible in a fossil state. The evidence of land vegetation is seen at the base of the Devonian, in fossil remains of Lycopodiaceous species, whose size is about the same as that of the larger club-mosses of our woods. They belong to the genus *Psilophytum*, established by Professor Dawson, of Canada, and evidently bear the characters of the club-moss family; branches unfolding like those of the ferns, by unrolling (circinate); stems dividing alternately by the forking, and bearing both upon their own bark and that of their creeping rhizomas, the scars or the marking of the point of attachment of the leaves. To this genus belongs one of the Silurian species mentioned above. Most of the fossil plants of this family are characterized and identified by the form and the position of these scars, which, though generally round upon the rhizomas, are rhomboidal and diversified indeed upon the stems. Originally, or when seen upon young branches wherefrom the leaves have been recently detached, these scars are small, scarcely the sixteenth of an inch in diameter; they increase, however, rapidly in size, proportionally to the enlarging of the stem, and upon large trunks measure sometimes one and a half inches in diameter. In the oldest and more remarkable order of this family, that of the *Lepidodendreæ*, the scars are generally contiguous and in spiral order. In another, that of the *Sigillariæ*, they are more generally placed in vertical series and at a distance from each other.

From the Lower Devonian, the predominance of land-plants becomes gradually more marked in ascending, but rather by the increasing size of the representatives than by their number. A few stems of *Lepidodendron* are recorded from the Middle Devonian. In the upper part, the remains of land-plants become of more frequent occurrence, and represent already all the vegetable divisions recognized in the subsequent period, that of the Carboniferous, and even more; for in the United States, at least, the Chemung Period has, in the *Lycopodiaceæ*, species of *Lepidodendron* and of *Sigillaria;* species of *Calamites* representing the *Equisetaceæ* family, a considerable number of ferns, already some of them typically allied to those of the coal, and a few species of uncertain relation, *Flabellaria* and *Noeggerathia*, known by long, striated, ribbon-like leaves, which have been considered as representing a family of vegetables intermediate between the *Lycopodiaceæ* and the *Cycadæ;* and it has also, which is more remarkable in considering the vegetable scale of distribution, large trunks of fossilized and solidified wood, recognized by its structure as representatives of a genus of Conifers, the

Araucariæ. Some species of this kind still exist in the flora of our time, inhabiting the southern part of the American continent, and the southern islands, New Holland and New Caledonia. The presence of these Conifers in the Devonian of North America is remarkable for two reasons: first, because they enter the land flora about the same time as the Lycopodiaceous species; and, secondly, because as yet no remains positively referable to trunks of Conifers have been recognized in the Carboniferous formation of the United States, though species of the same relation are described from the Subcarboniferous measures of Canada and of England.*

A few of the species of ferns of the Chemung group, or Upper Devonian, are related to some of the Coal-Measures, especially in the section of the *Neuropteridæ;* they differ, however, in their general facies and their specific and even generic characters. The Devonian type of the ferns passes up into the Umbral or Subcarboniferous formation of Pennsylvania; while in the West, where the Subcarboniferous is composed of a succession of limestone and sandstone strata, its flora is, on the whole, of the same type as that of the coal, though of course limited to a far less number of representatives. We have, then, in the East a Subcarboniferous flora of Devonian character; while in the West the formation which is considered as of the same age is with few exceptions of the Carboniferous type. The difference is attributable to that of the composition and of the formation of the strata.

The land flora of the Carboniferous period is known by the great quantity of fossil remains, corresponding, in their proportion, to the prodigious exuberance of a vegetation which has furnished the compound materials of the Coal strata. Concerning the character of the plants, the Coal epoch has been named the reign or the period of the *Acrogens;* the flora, from the base of the Millstone Grit, or even from the first traces of the lowest beds of the Subcarboniferous to the Permian, being represented especially by species of this class, Ferns, *Equisetaceæ,* and *Lycopodiaceæ*, as remarked already. The ferns are very numerous; nearly three hundred and fifty species have been described by European authors, and hardly half this number, as yet, is recorded from the North American Coal-Measures. They are classed and specially defined by the forms of the fronds and the leaflets and by the nervation. By these characters, the relations of the species of the same period to each other are sufficiently established; but not so well to the species living at this time, for the reason that these are generally classified and determined by the fructifications, which are rarely found in a fossil state, or not preserved distinctly enough to afford trustworthy points of comparison.

The first and most interesting group of these ferns of the Carboniferous measures is that of the *Neuropteridæ*, mostly representing bush-ferns of great size, whose widely-expanded fronds, many times branching, had compound leaves, with large cordate leaflets and a close flabellate nervation; their veins being either straight or curved backward to the borders, dichotomous or forked in ascending. The leaflets, which are generally found isolated or detached from the rachis when petrified, are in some roof-shales heaped and pressed upon one another in innumerable number, and thus, at first, they appear as if derived from trees; but in some localities, as at Pomeroy, Ohio, for example, the roof of the coal when exposed by the miners looks like a petrified ground, strewn with stems, branches, and leaflets of the same genus, without any trace of trunks. Some of the bushy stems (rachis of fronds) measure at the

* The presence of Conifers in the Carboniferous measures is, however, indicated, though less positively, by other kinds of organs, as remarked hereafter.

flattened base from six to ten inches in width. The family of the *Neuropteridæ* is apparently the more generally predominant in the Coal-Measures. Some of its species are found in the Subcarboniferous coal-beds of Arkansas, where they are mixed with a large proportion of remains of Lepidodendron; they become most numerous in the Lower Coal-strata above the Millstone Grit, together with large species of *Alethopteris*, and sensibly diminish in passing up to the Upper Coal beds. Two or three species only have been found with the Pittsburgh coal. In Europe, one species, *Neuropteris Loschii*, one of the most common plants of the coal flora of both continents, passes up into the Permian. The family of the *Pecopteridæ*, some forms of which are comparable to species of *Pteris* and of *Cyathea* of our time, has already some representatives in the Lower Coal, especially species of *Alethopteris*, with large leaflets. But it becomes more and more abundant in ascending, and in the upper part of the formation it is the principal representative of the fern flora. A beautiful species, *Pecopteris arborescens*, has been found in barren shales far above the Pittsburgh coal (or the productive Coal-Measures), and in Europe at least it continues on into the Permian. These *Pecopteridæ* are generally represented by branches and leaflets, which, many of them at least, are derived fragments from tree-ferns; their trunks, which are rare in connection with the Lower Coal beds, are locally very abundant in the Middle and Upper Coal-Measures.

In the family of the *Lycopodiaceæ*, the most interesting groups are those of the *Lepidodendron*, *Ulodendron*, *Sigillaria*, and *Stigmaria*, whose characters, as taken from the scars of their bark, have been briefly remarked upon already. The remains of *Stigmaria* are especially numerous in the whole thickness of the Carboniferous strata, and are distributed in every kind of rock except in the limestones. They generally fill the clay-beds under the coal, often appearing as the essential component of some of these beds, sometimes in a thickness of fifty feet or even more. They represent the rhizomas, or floating stems, of the *Lycopodiaceæ*,—*Lepidodendron*, *Sigillaria*, etc.,—these being the stems or trees that bear cones as their fructification. We recognize the same conformation in the club-mosses of our epoch, which, like *Lycophodium inundatum*, *L. arboreum*, etc., have creeping stems bearing, on the under side, long, thread-like filaments penetrating the ground, or rootlets creeping in wet mosses or soft mud, while their fruit-bearing stems are erect and have leaves and cones. The more ancient lycopodiaceous representatives in the coal are the *Lepidodendron*. The *Sigillaria* appear later and persist longer. While *Lepidodendron* species have not been as yet recognized in connection with the Pittsburgh coal, many species of *Sigillaria* are there. *Sigillaria Brardei* has been found, filling by its remains a bed of sandy shale far above the Brownsville coal, which is the highest workable bed of Pennsylvania, already three hundred feet above the Pittsburgh coal. In Europe, one species at least of this last genus passes up to the Lower Permian.

The *Equisetaceæ*, or Horsetail species of the present time, have cylindrical, articulated stems, scarcely measuring one inch in diameter. The principal species of this group occurring in the Coal-Measures, the *Calamites*, were trees similar in their structure, with hollow articulated trunks and striated surfaces, but comparatively of great size; their trunks varying from two to eight inches in diameter. Their branches were borne at and around the articulations, and they had at the nodi whorls of narrow, small, linear-lanceolate, sharply-pointed leaves. As these branches are rarely found attached to their stems, they were for a long time considered as representing distinct species, and separated in the de-

scriptions under the fine name of *Asterophyllites*.* These *Calamites* had a rapid development; their stems grew close to each other, forming dense thickets, like the canes of the southern swamps, which each year rise up impenetrable groves by their compact vegetation. The *Calamites* appear early in the Subcarboniferous, even in the Upper Devonian; they persist longer, passing up to the Permian, where they are represented by large species of the *Equisetum*. They have entered by their remains into the formation of all the beds of coal, and in some localities become the essential compound of the combustible matter.

Some other genera of the Carboniferous flora are represented by floating water-plants of comparatively small size and of more indefinite relations. The more important are the *Annularia*, or plants whose branches surrounded the stems, like the ribs of an umbrella, and whose cylindrical or flat lanceolate leaves, larger than those of the *Asterophyllites*, are, like them, placed in rows around the articulation of the branches, like the spokes of a wheel. The *Sphenophyllum* also, with stems divided in about the same way as those of the former genus, had their leaves also in whorls, but flat, enlarged upward or wedge-form from the base, and with a nervation analogous to that of the ferns. These two genera represent apparently a family of plants intermediate between the *Equisetaceæ* and the *Lycopodiaceæ*. They are widely distributed in the whole extent and thickness of the Coal-Measures, and limited to this formation. Like the *Calamites*, they are represented by few species, with, however, a very active and luxuriant vegetation, as indicated by the profusion of their remains. It was the same with the long ribbon-like leaves of *Flabellaria*, varying from one to three inches broad, which have been remarked upon already in the Devonian flora. Though their remains are most abundant in the Carboniferous, no plant has yet been found in connection with its essential organs, the fruit. The leaves embrace at the base a stem of from one to two inches in diameter, but even this stem has been very rarely observed.† The relations of these plants have therefore exercised the researches and ingenuity even of paleontologists without a satisfactory result; for this relation is still as uncertain as when, years ago, the celebrated Corda made the well-known analysis of the texture of a stem. The leaves evidently represent different species, but their characters are uncertain. They have been described by authors under the name of *Flabellaria*, *Cordaites*, etc.; and now Schimper, in his great work on vegetable paleontology, recalls the old name of *Pycnophyllum*, formerly proposed by Brongniart. Such are many plants of the Coal-Measures, whose characters and relation are vaguely pointed out by isolated organs, fruits, leaves, or stems, and whose true nature is a secret which may only be revealed by new discoveries. The remains of these *Flabellariæ*, which first appear in the Upper Devonian and have numerous representatives of two species in the strata of the Lower Carboniferous, become still more abundant in

* Species of *Asterophyllites* are considered by some authors as branches of *Calamodendron* and as referable to the Conifers.

† Recent researches of Grand'Eury in the coal-basin of St. Etienne, France, seem to prove that the genus *Cordaites* was represented in the Coal-Measures by numerous species with stems sometimes of 60 to 70 feet high, all bearing long ribbon-like leaves at the top of their branches, and referable by the texture of the stems to the Conifers. To the same naturalist is due the discovery of a large number of fruits referable to the genus *Cardiocarpus* and *Rhabdocarpus*, preserved in a silicified state, which have been analyzed by Brongniart, and considered also by him as fruits of Conifers. The same view was exposed already in 1870, in the fourth volume of the Geolological Reports of Illinois, p. 493, and the name of *Ptilocarpus* proposed for the generic clasification of winged fruits referable to Conifers.

the Upper Coal-Measures, and, in Europe, pass upward and into the Permian.

A summary sketch of the flora of the Carboniferous cannot even give an idea of its luxuriance and fecundity. From the immense amount of materials which it has given to the production of the coal, and from its general characters, it indicates, for the conditions of the atmosphere at this period, an extremely humid, rather than a very warm climate. The whole atmosphere was impregnated with vapor, and, in consequence, with a proportionate amount of carbonic acid. These elements played the part then that they do now, promoting the activity of the vegetation to the highest degree, especially that of the Ferns and the *Lycopodiaceæ*, which, by their present vegetation, show their partiality for foggy countries or the shade of humid forests, and of the *Equisetaceæ*, which live in swamps. The ferns were of much larger size then than they are now, either as bushy species or as trees. Fossilized trunks of ferns have been found in the Ohio coal-fields measuring more than one foot in diameter; while at our epoch, and even in the tropical regions, the trunks are rarely half as large. The stems of our present species of Lycopods and Horsetails are scarcely half an inch thick, while trunks of *Sigillaria* and *Lepidodendron* have been recorded as measuring two feet in diameter, and, as remarked above, the stems of the *Calamites* vary from two to eight inches in thickness.

This giant vegetation was not, on account of its huge proportions, deprived of beauty; on the contrary, here, as everywhere, nature seems to have given splendor to its work in proportion to, and as a compensation for, the deprivation of animal life. The harmonious elegance of the coal flora is clearly manifested by its remains preserved by fossilization. The trunks of fern-trees, as those of *Sigillaria* and of *Lepidodendron*, of an exact cylindrical shape and of the same size in their whole length, finely carved upon their bark in spiral or vertical rows of scars, of diversified and always symmetrical and elegant patterns, represent the most elaborate designs of architecture. They are like fluted columns of Corinthian or Doric order, covered from base to top by garlands and arabesques, and crowned by capitals of equally elaborate style. These, adorned by depending fronds of parasitic ferns, support, as roofs, spreading recurved branches, arches, cupolas, domes, painted by the multiple forms of fern-leaves, more diversified and more graceful and fair than could be any ornamentation inspired by the imagination and executed by the skill of the greatest painter. Under this canopy and in this dark temple of nature, wherein, as in the great cathedrals of old, a gloomy, subdued light penetrates only by bow-windows, fringed and latticed by interlacing ferns and branches, the ground is strewn by vegetable *débris* entombed under mounds of verdure. Upon the wide open surface of the swamps and bogs, the vegetable life still manifests its power by extending, over the whole, thick carpets of water-plants with the interlaced floating rhizomas of *Stigmaria*, over which are raised and supported groups of *Calamites*, whose graceful branchless stems recall the forms of Moorish minarets when seen from great distances on approaching the borders of the sandy deserts. There is not a paleontologist whose admiration has not been deeply excited by the study of the fossil remains of the flora of the Coal formation. Some have tried to represent its aspect by the design of the painter; but designs, like descriptions, are vain in an attempt of this kind.

From the Carboniferous period, there is in this country an immense interruption in the succession of the geological formations, and consequently a corresponding blank in that of the geological floras. The Ameri-

can Permian, mostly represented by magnesian limestone, has till now contributed to paleontology but a few specimens of *Calamites* only. In Europe, the flora of this period, known especially by an admirable work of Göppert, is composed of Ferns and *Equisetaceæ*, with very few *Lycopodiaceæ* and many Conifers of peculiar type,—the *Volzia*, *Valchia*, *Ullmannia*, etc.; types limited to this formation, without known precursors, and with few successors. It has, however, a dozen species of Conifers, known by the texture of the fossilized trunks, and referable to that genus *Araucaroxylon* to which belong the fossil trunks of our Devonian.

We have seen that some species of the Carboniferous ferns ascend in Europe to the Permian. Even the American species of some localities (some of those, for example, represented in the concretions of Mazon Creek, Illinois) have a facies which appears to Schimper so evidently Permian, that he is disposed to refer them to this formation. These concretions, however, like the coal-strata with which they are connected, are in our Lower Carboniferous. They overlay at Morris the Subcarboniferous limestone, and at Colchester are separated from the Millstone Grit by only a few feet of strata, and, besides the connection of these plants in the same strata with remains of *Lepidodendron* and their fruits, large species of *Alethopteris*, etc., is sufficient evidence of their age.

The flora of the Trias is not distinctly represented in the North American geology; for the deposits of coal near Richmond, Va., and in North Carolina, referred to this period, are, from the character of the fossil plants, rather related to the lowest member of the great Jurassic period—the Triasso-Jurassic or Rhetic of the European geologists. These plants represent a few species of *Equisetum* and a large number of Ferns, wherein the genera *Pecopteris* and *Sphenopteris* are scantily represented. One of the most remarkable types is that of *Clathropteris*, a fern with large runcinate leaves, whose form and areolation in broad square areas bear some likeness to leaves of dicotyledonous plants. The essential components of the coal, however, as indicated by the fossil remains, are *Cycadæ*,—*Podozamites*, *Pterophyllum* especially, and Conifers of a peculiar group of the Firs. This fossil flora is not satisfactorily known; its characters appear intermediate to those of the Triassic, where begins the reign of the Gymnosperms, which continued on through the whole Jurassic period.

These are the dark ages of the vegetable world. In the North American continent, not a single plant is known as yet from the Jurassic, which, in its subdivisions—Lias, Oolith, Corallien, and Wealden—is represented in some parts of Europe by many thousands of feet of measures. Even in Europe, the vegetation of this period is comparatively little known. Scarcely five hundred species of plants have been as yet recognized from the whole of its divisions. Of these, sixteen per cent. are referable to *Algæ*, or marine plants; four to *Equisetaceæ;* forty-one to Ferns; and forty-five per cent. to Gymnosperms; of these, twenty-nine per cent. are *Cycadæ*, and the balance, twelve per cent., Conifers. A few monocotyledons of uncertain relations, mostly *Yuccacites*, with two species of *Chara*, are described from the upper stages of this formation. Of course, we do not know what riches of vegetable remains this long period may keep in reserve for the study of future paleontologists. It is, however, fair to presume that the essential characters of its flora are known already, and that, indeed, it is essentially composed, for the land vegetation, of Acrogens, and especially of Gymnosperms. Till the Cretaceous period, no traces of dicotyledonous plants have been recognized.

This brings us to the examination of a number of fossil plants recently

discovered by Dr. F. V. Hayden in his geological explorations of the Western Territories, a discovery which has justly excited a great interest among all the paleontologists of this age. These plants represent the Cretaceous flora of the Dakota group.

This formation covers a wide area along the Missouri and Platte Rivers, and in Kansas, Nebraska, and Minnesota, extends from Texas to the northern limits of the United States, in a width of seventy to one hundred miles, and passes farther north into the English North American possessions, even apparently to Greenland. Along a portion of its eastern border, as in Kansas, it overlies immediately, without any kind of transitional strata, the Permian limestone; while near the base of the Rocky Mountains it rests directly on rocks containing Jurassic fossils; and, therefore, as its animal fossils are all Cretaceous, it represents as yet the lowest American Cretaceous. By the relation of some of its fossil remains, however, its synchronism seems to be with the Middle Cretaceous of Europe. In this formation, generally of reddish ferruginous sandy shale, vegetable remains are, if not in profusion, at least tolerably abundant, and especially in a fine state of preservation. They are mostly leaves, with a few fruits and a few stems, from which the relation of generic types at least, if not of species, is ascertainable. This Cretaceous flora, now known by more than one hundred species, has not preserved any of the antecedent types, not even of those of the Jurassic, the immediately preceding age. The Ferns and the Conifers are few, and all represent new forms. One vegetable only is doubtfully referable to *Cycadæ;* and, what is the more remarkable, this flora mostly represents dicotyledonous plants, some of them representing types of the essential genera into which our present arborescent vegetation is distributed. From the Lower Cretaceous of Europe, no dicotyledonous plant has been described up to the present time; one only has been recently recognized by Heer in the Old Cretaceous of Greenland, where the flora has still great affinity with that of the Jurassic, especially by a preponderance of *Cycadæ.* It is therefore clear that the discovery of a group of plants manifesting characters related to those of our present flora, and found in connection with a formation referable by its animal remains and its geological station to the Old Cretaceous, should be of great interest to science.

The monography of the fossil plants published in the reports of Dr. Hayden* describes five species of Ferns, one doubtful Cycad, six Conifers, three monocotyledonous, and the balance all dicotyledonous, representing genera distributed in all the divisions of the present vegetable scale: the apetalous, gamopetalous, and polypetalous. It is natural to suppose that the limitation of species represented merely by leaves cannot be very precise and accurate. But the value of the species has not to be considered for the relation of this Cretaceous flora; only the typical forms characterizing genera, which may be recognized easily, even by those who are scarcely acquainted with botany. The leaves of the beach, for example, those of the platan or buttonwood, of the tulip-treè, the sweet-gum, the poplar, the magnolia, the walnut, even those of some sections of our oaks, like that of the chestnut-oak, positively identify the genera which they represent. The table of the genera to which the forms of the Cretaceous leaves are referable has, among others, *Liquidambar*, *Populus*, *Salix*, *Betula*, *Myrica*, *Celtis*, *Quercus*, *Ficus*, *Platanus*, *Laurus*, *Sassafras*, *Diospyros*, *Azalia*, *Magnolia*, *Liriodendron*, *Menispermum*, *Negundo* or *Acer*, *Paliurus*, *Rhus*, *Juglans*, *Prunus.* From this list, seventeen of the genera are those to which belong

* Report of the United States Geological Survey of the Territories. F. V. Hayden, geologist-in-charge. Vol. vi.

the species of trees and shrubs which have at the present time the more general and the widest range of distribution. Indeed, most of the genera of the arborescent North American flora are represented in the Cretaceous by analogous types, with the exception of those which are characterized by serrate, denticulate, or crenate leaves, like *Tilia*, *Æsculus*, the serrate *Rosaceæ*, *Hamamelis*, *Fraxinus*, the *Urticineæ*, like *Planera*, *Ulmus*, and of the *Amentaceæ*, *Betula*, *Alnus*, *Carpinus*, *Corylus*, *Carya*, etc., all with serrate or dentate leaves. The more appreciable and general characters of the Cretaceous leaves are a generally thick coriaceous substance and the integrity of the borders. From this it is possible to derive some reliable conclusions in regard to the origin of the more marked types of the North American arborescent flora; and, by correlation, to recognize the climatic circumstances governing the flora of the Cretaceous Dakota group, as nearly identical, for the temperature, at least, with those of the North United States at the present time.

The Dakota group is overlaid in the West and to the base of the Rocky Mountains by more than two thousand feet of measure, marine formations only, characterized as Cretaceous by an abundance of animal remains. The upper member is composed of heavy beds of black shale, with species of *Inoceramus*, *Baculites*, *Ammonites*, *Belemnites*, etc. To this are superposed the lowest strata of the great Lignitic, a series of layers of sandstone and of clay-shale, with remains of marine plants, well-preserved Fucoids, and minute fragments of land-plants. This big sandstone, as it has been generally called, is overlaid by the productive Lignitic measures, whose distribution in beds of coal, with underlying clays and overlying shales generally holding in their composition a profusion of fossil remains of land-plants, with intermediate beds of sandstone, etc., is remarkably similar to that of the Carboniferous measures. The comparison of these coal formations of different periods would be very interesting now; but the present sketch has to be limited to the consideration of the essential characters of the American geological floras only.

From a theoretical point of view, it would seem rational to suppose that, in ascending higher in the series of the geological formations, and in coming nearer to the present epoch, we should find a constantly and gradually more distinct relation between the ancient floras and that of our time, and that, therefore, the plants of the Lower Lignitic, though intimately allied to those of the Cretaceous, should still bear a closer relation to those of the present North American flora than do the Cretaceous leaves. This is, however, not the case. The Lower Lignitic flora has not as yet a single species identical with any of the Cretaceous, and even very few have a distinct relation to them. Its more essential character is marked by the presence of Palms, whose remains, especially those species of Sabal, are in profusion, though appearing here as the first representatives of this family, at least in the geological ages of this continent. As seen by some of their trunks and leaves, they are of great size, and in such a proportion that at some localities, as at Golden City, Colorado Territory, they seem to have composed one-fourth of the vegetation of that time. They are, moreover, present in the whole extent of the Lower Lignitic; specimens of their leaves having been collected from Placière Mountain in New Mexico, to Fort Union on the Missouri River, or from 36° to 49° of latitude. In the Lower Lignitic, and in connection with the Palms, are leaves of *Ficus*, *Cinnamomum*, *Magnolia*, *Myrica*, *Quercus*, *Platanus*, *Diospyros*, *Mamnus*, *Viburnum*, etc., rather related by their forms to southern than to northern types. The prepon-

derance of Palm remains indicates for this flora a climate different from that of the Dakota group. In considering the numerous and thick coal-beds of the Lignitic, it is evident that the atmosphere was, at this epoch, charged with a high degree of humidity, which, tempering the climate by diminishing the extremes of heat and cold, furnished the conditions for a different kind of vegetation. Circumstances similar to those remarked at the Carboniferous period are reproduced in the Lignitic, where also extensive flats, wide surfaces of land slowly emerging from the sea, were for a long time under an atmosphere of fogs and vapors. The vegetation was then somewhat similar in its aspect to that of the swamps now along the Gulf shores of the South; and thus, in comparing the flora of the Dakota group to that of the Lower Lignitic, their general facies indicates about the same difference of temperature as is marked at the present time by the vegetation of Ohio as compared to that of Southern Louisiana and Florida, where the Palm family is represented by Sabal and Chamærops. The relation of the flora of the Lower Lignitic with that of our time is more distinctly marked by the Magnolias, which closely resemble living species, at least as to their leaves. The Oaks are more numerous also. Among them appear the first type of the group of our Black and Red Oaks, with deeply-lobed leaves, like those of *Quercus lyrata* and *Q. falcata.* The Lignitic flora has, besides, species of *Cornus*, *Vitis*, *Nelumbium*, *Sapindus*, *Zizyphus*, well characterized *Juglans*, *Glumaceæ* like *Arundo*, *Phragmites*, *Carex*, and a considerable number of large Ferns; *Woodwardia*, *Pteris*, *Lygodium*, all genera represented now in the North American flora, and not in that of the Dakota group. The Maple (*Acer*) is not positively recognized in the Lower Lignitic. *Betula* and *Alnus* are as indistinctly and sparingly represented as in the Cretaceous flora. About two hundred species have been already described from the Lower Lignitic of the Rocky Mountains and of the Mississippi.

Considering the distribution and the relation of the plants found at different localities, the Tertiary formations of the Rocky Mountains have been divided into four sections: 1st. The Lower Lignitic, whose flora has been remarked upon, is referable to the Eocene; 2d. The Evanston group, considered as Upper Eocene or Lower Miocene; 3d. The Carbon group, or Middle Miocene; 4th. Green River group, or Upper Miocene.

The flora of the second group is represented as yet by about ninety species, of which nearly one-third are identical with those of the lower stage. It has a number of fruits, which have been considered as referable to Palm; but no leaves of Sabal or of other species of this family have been found with them. Therefore, the presence of Palms in these beds is still uncertain. The fossil plants of this section have, for the first time, a number of species, with dentate and serrate leaves, of *Salix*, *Betula*, *Alnus*, and *Acer*.

The general characters of the flora partake of both those of the first and third group. Its plants, however, should be more abundantly collected and better known before its geological station is definitely fixed. It may represent merely an upper member of the first group. The third group is especially known by the fossil plants, which are found in abundance in the shale overlying the Lignite beds of Carbon; they represent a flora mixed in its characters, and consequently of great interest. Its general facies is positively Miocene; for of the fifty-six species which represent it, eighteen are identical with forms of the European Miocene, and thirteen with those of the Arctic flora described from Alaska, Greenland, and Spitzbergen. It has still, however, a few species that may be considered remnants of the Lower Lignitic, and are not present in the Arctic

Miocene: among others, a *Cinnamomum*, a *Ficus*, a *Smilax*, and a *Rhamnus;* the last two represented by large leaves. It unites, therefore, in its characters, Miocene Arctic types with Miocene types of Middle Europe, and a few of those of the Lower American Lignitic, considered as subtropical. This reunion of types at the same point indicates the wide extent of the thermal zones during the Miocene period, as well as the concordance of the floras with synchronous Miocene formations over wide areas, even under distant degrees of latitude. It therefore disproves the idea of a succession in time of formations bearing identical characters so far as their fossil remains are concerned, and thus complicates, at least for this country, the question of the migration of species and of their derivation from a particular point.

The flora of the Carbon group has some of its species scarely different from species of our present flora, which may be considered as their offspring. *Populus latior* is represented now by *P. canadensis*, *P. monilifera*, *P. angulata*, three closely-allied species as variable and difficult to fix in their characters as is the Miocene species. The North American species of *Corylus* are scarcely distinguishable from *C. Macquarryi*, very abundant in the Miocene of Alaska and Greenland. Our *Platanus occidentalis* is a mere modification of *P. aceroides*, as both *Acer saccharinum* and *Acer dasycarpum* are traceable with the same degree of evidence to *Acer trilobatum*. A number of leaves are referable to a species of *Asimina*, similar in form and nervation to those of our Papaw; being, however, smaller. In the Conifers, we have, at Carbon, *Sequoia Langsdorfii*, closely allied to *S. sempervirens*, the most common arborescent species of California, and *Taxodium dubium*, with which *T. distychum*, the bald Cypress of the southern swamps, is apparently identical.

The fourth group, referred to the Upper Miocene, is distinct from the Upper Lignitic, which it overlies in patches of moderate extent. It is a fresh-water formation, mostly of laminated calcareous clay-shale, more or less impregnated with bitumen, the result apparently of the periodical drainage of shallow lakes and swamps. In places, this shale holds a profusion of vegetable fragments, especially representing Conifers, with insects, feathers, and scales of fishes. At some other localities it has no plants whatever, but instead skeletons of small fishes in equal abundance. The flora of this group is related to that of the European Miocene in a less degree than the former. By its types, and essentially by its facies, it is more closely allied to that of North America at the present time. Its Conifers are referable to the genera *Taxodium* in two species, *Sequoia* in three: *Thuga*, *Glyptostrobus*, *Pinus*, and *Abies*. It has also a number of species of *Myrica* and *Salix* closely allied to living species; and an *Ampelopsis*, a *Staphylea*, species of *Ulmus*, *Planera*, *Ilex*, *Juglans*, etc., all specifically related to recent types. From the preponderance of Conifers and shrubs, the climate of this epoch appears to have been somewhat colder than at the former period.

In considering the distribution of the plants in the whole Tertiary of the Rocky Mountains, there is evidence of a slow upheaval of the land, of a comparative diminution of atmospheric humidity, and consequently of a lowering of the temperature. During the process of formation of this fourth group, the ground had become hilly, if not already mountainous or subalpine; the land was a succession of valleys, hills, and lakes; the uplands covered with forests of Conifers, the swamps and the dales with shrubs, willows, wax-myrtles, numerous species of holly, sumac, etc. The Lignitic precedes in its formation the upheaval of the mountains, while the strata of the Green River group were deposited during the period of upheaval. The flora of the fourth group, known

as yet by about eighty species, has only ten species common to the three former groups; and even six of these are so-called omnipresent species, or present in the whole thickness of the Tertiary. It has, however, thirty-two of its species identical with species of the European Upper Miocene, and none positively identical with any living at our time. It cannot, therefore, be referred to the Pliocene age.

This review should not be closed without a few remarks on the floras (too little known as yet) of some more recent geological epochs. A large number of specimens, representing about forty species, have been obtained, in a very fine state of preservation, from the chalk-bluffs of Nevada County, California, referred to a Pliocene formation. These plants are related in a more evident degree to those of the present flora by their general facies and by a few identical species. Except two or three of the types referable to Asiatic (Japanese) origin, they are American, especially related to species of the eastern slope of the continent, and, by a few, to species still in the flora of the Rocky Mountains. Remarkably enough, some genera, like *Ulmus*, for example, are represented in the specimens of the chalk-bluffs by a large percentage of the remains, while they are at our epoch absent from the flora of California. A formation of apparently the same age is present in the chalk-bluffs or clay-beds bordering the Mississippi River below the mouth of the Ohio, near Columbus, Ky. Too few species have been as yet collected from that formation, and thus nothing positive can be said about its flora. Its relation seems to be very marked with the present flora of the Southern States, or rather of the Gulf shores. *Planera cymelini*, *Quercus virens*, and species of *Ulmus* have been described from that locality. No doubt that when its fossil plants have been collected very valuable indications will be obtained from their study in regard to their relation with more ancient types and transitional forms from the old ones to those of the present flora of North America.

To this chain other links can be added in the future. The Drift of the West, in Ohio and Indiana especially, is interstratified by deposits of leaves and trunks; also, by peat formations, where a profusion of vegetable remains are obtainable for studying the progress of the vegetation during the Glacial epoch. Still nearer the present time, and corresponding to the Terrace epoch, thick beds of leaves heaped along the Lower Ohio River are open to the researches of the paleontologist. There the leaves, still undecomposed, mixed with sand and clay, are pressed together in banks, which are cut in stages like terraces. They represent mostly species of our flora; but some differences of character may be found there as a clew to the mode and progress of modification under various and appreciable kinds of influences.

This would complete the chain of evidence in regard to the development and succession of the types of the North American flora from the Cretaceous to the present time. What an admirable record is in reserve for the botanist who shall be disposed to give his time to the noble task of deciphering and of transcribing it! There is certainly not a country in the world where the study of the geological floras, of their characters and successions, can be pursued with more advantage, and furnish at the same time more important and more trustworthy documents, than in the United States; for, except the Jurassic and the Permian, the groups of the geological floras are represented in our formations by abundant and generally well-preserved materials, and the distribution of the strata is so distinctly marked that their age and succession are easily determined. Therefore, the deductions which are likely to be

derived from the study of their vegetable fossil remains will have a great degree of positiveness and reliability.

Researches in the vegetable world of the old periods of our earth are now pursued with great activity by some of the greatest and noblest minds of Europe. From Greenland to Italy, from the borders of the Atlantic and of the Mediterranean in France to the eastern limits of Russia, specimens of fossil plants are collected, sent to museums, examined and described by authors of celebrity, and their valuable works constantly discover a greater importance in vegetable paleontology. In this country, this branch of science has few adherents; for the reason, perhaps, that we lack till now good collections and special libraries, and also because it is not of immediate application to the material welfare of the human race. It has, however, kept pace with the prodigious scientific development of the last quarter of the century. In 1850, the fossil land-plants known from the North American formation were only eighteen species, described by Brongniart in his *Végétales fossiles*, from specimens sent to him from the Coal-Measures by Professor Silliman. At the present time, more than one thousand species have been described from the various geological formations of this country. A number of students are, moreover, ardently searching for and gathering specimens; and the museums of natural history of the best scientific schools have a section for vegetable paleontology.

Already the study of the North American fossil plants has supplied, in regard to the distribution of the species at different periods, some important information, which modifies a few of the conclusions derived from European vegetable paleontology. Though the isothermal zones have been evidently of a width proportionate to the age of the geological periods, producing in the Carboniferous times, for example, uniformity of vegetation over the whole northern hemisphere, if not over the whole surface of the earth, it appears that there was already at this period a continental or local facies marked in the groups of vegetation. The North American character is recognized in the coal flora of this continent by Schimper, in his *Vegetable Paleontology*, as it has been for a long time exposed by the works and descriptions of American authors, and this facies becomes more and more distinct in the more recent periods. The precedence of vegetable types in the geological flora of this continent is distinctly recognized, and, therefore, the hypothesis of the derivation of the North American flora from Miocene European types is necessarily set aside. On this last question, former remarks in this paper prove the unity of the present flora, derived by constant succession of related vegetable forms from the Cretaceous at least. On the question of precedence of vegetable types, it has been remarked that the appearance of land-plants is positively recognized in the Silurian of Michigan, while no land-plants have as yet been described from formations lower than the Middle Devonian of Europe; that also we find already in the Devonian of the United States, trunks of Conifers recognized as prototypes of the *Araucaria*, which are only found later, in the Subcarboniferous of Europe. Our Carboniferous flora has a number of its forms appearing later in the Permian of Europe. The Triassic flora of Virginia and North Carolina is half Jurassic. A number of Cretaceous genera of the Dakota group are reproduced in the Miocene of Europe, as they are, too, in some of the North American Tertiary vegetable groups, and also in the flora of this epoch. Therefore, the relation of the European Miocene seems partly referable to the American Cretaceous. And in following the comparison upward, we find, in what is considered the Eocene of the Lignitic of the Rocky Mountains, a larger number of forms identical or closely

allied to European Miocene species, while the Miocene group of Carbon represents the youngest type of the Tertiary flora of Europe and Greenland, with species of *Platanus*, *Acer*, etc., scarcely distinguishable from indigenous species of our present flora.

More important questions than these, but as yet problems only, belong to the domain of vegetable paleontology. Is the multiplication and succession of species a result of gradual modifications of organs or of a spontaneous production? No positive answer has been given to this question, which occupies the mind of every naturalist, and which, as Gray justly says, is a problem whose solution is reserved to vegetable paleontology. Fossil plants are documents relating to the past history of the world. They have recorded in their characters the physical conditions of the atmosphere from the earliest period. Science has as yet deciphered few incomplete fragments of these records. Every student may read a page or a line of this admirable book. As vegetable life is the promoter of animal life, it precedes and explains it. No one knows as yet in what relation the characters of the representatives of both kingdoms may stand, and whether the animal forms may not be explained or surmised by those of the plants. On the one hand, especially, in recognizing the transitions which unite some species, modifications which appear in plants as resulting from atmospheric influence, it seems as if the development of the vegetable world was subject to mere material laws. On another hand, every naturalist is forced to acknowledge not only a profound intelligence in the plan, in the admirable harmony governing the vegetable world even in its minutest details, but to recognize also and to proclaim omnipotent prescience and providence in the preparation of the materials which, as a presage of the advent of man, have been garnered up in his abode and by the world of plants for the fulfillment of his future destiny.

The possibility of ever being able to answer questions of this kind has been denied to vegetable paleontology on account of its want of precision in the determination of vegetable remains. But this science is in its infancy; and the childhood of science is marked, like that of man, by a series of trials and failures, from which strength and proficiency are derived. The first astronomers did not measure the distance from the earth to the fixed stars, nor weigh the planets by the diameter of their orbits. Hooker himself, the most precise and careful analyzer of botanical characters, recognizes the accuracy of the determinations of Heer in his admirable work on the Tertiary flora of Switzerland. The award of the great Wollaston medal to the celebrated professor of Zürich sufficiently proves the appreciation of the services rendered to science by vegetable paleontology, and the high rank which it has already attained in Europe.

NOTES ON THE GEOLOGY OF SOME LOCALITES NEAR CAÑON CITY, FREMONT CO., COL.

By S. G. WILLIAMS.

Dr. F. V. HAYDEN, *United States Geologist:*

DEAR SIR: I take pleasure in forwarding to you, according to your request, some sections, with brief notes thereon, made by me during the summer of 1874, in the course of some explorations of coal and oil lands in Fremont County, Colorado.

Yours, respectfully,

S. G. WILLIAMS.

CLEVELAND, *March* 31, 1875.

The oil-springs mentioned in your report for 1869 are in the cañon of Oil Creek, a northern tributary of the Arkansas, which flows down from the flank of Pike's Peak, between the main range and a lofty spur that is sent off to the southeast, and dies out in the plains a little north of the Arkansas. Thus the rocks from which the oil-springs issue are, as you have suggested, in a synclinal trough, of which the axis is near the main range, while the cañon of Oil Creek is cut through near the foot of the spur. I sent a trusty person on horseback up through the park which lies at the head of the cañon, and, from his observations and my own, I can give the following section, which extends from the head of Oil Creek Park to the Arkansas River, about fifteen miles from north to south.

Descending section.

	Feet.
8. Alluvium, underlaid by Cretaceous shales, Arkansas Valley	.....
7. Black shale, with layer of sepdaria, and *Baculites*	50
6. Limestone of drab color	15
5. Thick-bedded ferruginous sandstone	40
4. Red and yellow sandstones, often thick-bedded, with occasional layers of bluish shale	1,000
3. Bright-red sandstones	100
2. Mottled marble	15
1. Whitish limestone, weathering rough, and full of caverns; bottom not seen; visible	50

These thicknesses are all estimated, except Nos. 1, 2, and 3. Dip a little west of south 15°. Nos. 1 and 2 are probably Carboniferous; rocks holding the same relative position in the Arkansas Cañon, and from which I have fossils, are certainly of that age. No. 3 is probably Triassic. No. 4 may be Jurassic, in whole or in part. I forward you the only fossil I found in this series of strata, a *Gasteropod*, found a little more than 200 feet above the base of No. 4, at the horizon of the oil-springs. Nos. 5, 6, 7, and 8 are undoubtedly Cretaceous. Nos. 5 and 6 form a steep ridge, capped by No. 6 a little south of the mouth of the cañon. No. 7 forms a second ridge still farther south, the summit of which is preserved

from denudation by a remarkable layer of calcareous septaria from 3 to 6 feet in diameter, which afford splendid crystallizations of calcite and numerous fragments of a large species of *Baculite*. The largest fragment that I saw was a foot in length, and fully 4 inches in diameter, showing the corrugated divisions of the chambers through its entire length.

The oil-springs are about 200 feet above the base of No. 4. They now yield about 3,000 gallons a year, which, by a rude process of distillation on the spot, affords 55 per cent. of illuminating-oil and 15 per cent. of benzine. An effort has been made to find oil by a deep boring, which, at the depth of about 200 feet, ended in crumbling red sand, doubtless No. 3. The nature of the strata in which these oil-wells are situated, with what we now know of the underlying rocks, does not afford any very favorable prospect of a large supply of oil from this locality.

I made a somewhat careful examination of these Tertiary strata along their outcropping edges for seven miles, and two sections across their thickness, up the ravines of Oak Creek and Coal Creek, and am able to present the following section, in which most of the thicknesses were measured, though a few of the larger bodies of rock on Upper Oak Creek were estimated. The portion examined was in township 19 south, range 69 west, and township 19 south, range 70 west, of sixth meridian, Fréom t County.

Descending section.

	Ft.	In.
31. Sandstones and shales	......	
30. Coal G, left bank Upper Oak Creek	4	6
29. Shale and sandstone, Upper Oak Creek (estimated)	100	0
28. Coal F, right bank Upper Oak Creek	1	6
27. Drab sandstone, Upper Oak Creek (estimated)	200	0
26. Black and drab shales, Upper Oak Creek (estimated)	200	0
25. Yellow sandstone, Oak Creek	10	0
24. Sandstone, Upper Coal Creek (estimate)	30	0
23. Shale, Upper Coal Creek	10	0
22. Coal E, Upper Coal Creek	1	4
21. Brown shale, partly covered, Coal Creek	6	0
20. Sandstone, Coal Creek	20	0
19. Shale, Coal Creek	9	0
18. Coal D, Coal Creek	3	6
17. Dark shale, Coal Creek	7	0
16. Coal C, Coal Creek	2	0
15. Black and drab shale, with Coal B′, 1 foot 8 inches, Coal Creek	40	0
14. White sandstone, Coal Creek	4	0
13. Drab shale, Coal Creek	2	0
12. Drab sandstone, Coal Creek	25	0
11. Dark shales, with two coal-seams, each 1 foot, Coal Creek	46	0
10. Sandstone (thickness estimated), Coal Creek	80	0
9. Shale, with coal-seam 1 foot thick, Coal Creek	25	0
8. Coal B, worked by Denver and Rio Grande Railroad Company, Coal Creek	6	0
7. Fire-clay, Coal Creek	1	6
6. Coal A′, Coal Creek	1	8
5. Fire-clay, Coal Creek	0	8
4. Sandstone, etc. (thickness from R. N. Clark, M. E.)	80	0
3. Coal A, Macomber's Gulch	4	6
2. Adobe clay, thickness from R. N. Clark (Castle Rock)	80	0
1. Cretaceous	......	

Thus the thickness of these coal-bearing strata, exclusive of the beds above the uppermost coal, is 1,000 feet.

Coal A, at a slight opening in Macomber's Gulch, is quite friable, though it will undoubtedly present a better appearance when worked beyond the influence of the weather. This is doubtless the coal penetrated by Mr. Teller, of Central City, in a boring made a few years ago near the railroad-company's mine, and which is reported there to have been of superior quality. Mr. Teller was, however, unable to furnish an accurate record of this boring.

Coal B is the one which has been worked for several years on Coal Creek by the Denver and Rio Grande Railroad Company, and its quality has been tested by pretty extensive use. This is the coal the analysis of which as from Canyon City is given in your report for 1873, as also in Raymond's Report on Mineral Resources, dated 1873, from which analysis its calorific power is shown to be superior to that of any other western lignitic coal. It endures exposure to the atmosphere as well as the most of the bituminous coals of Ohio, and burns freely on the grate-bars of a locomotive, with a strong heat and without crumbling. I am told that it is a favorite coal for domestic use in Denver.

Coals C and D will, I think, when worked, prove to be of as good quality as Coal B. At their outcroppings, in the ravine of Coal Creek, they present vertical faces, with but little tendency to crumble, even from this long-continued exposure to the weather. The shale which separates them at the outcrop may very possibly thin out when worked to such a degree as to make it practicable to work the two seams together.

Coal E, although thin, is of good quality, and has somewhat the external appearance of a cannel.

The entire series of beds on Coal Creek and on Oak Creek, nearly to its head, dips gently westward at an angle of about 7°. Near the head of Oak Creek, however, where it begins to cut its deeply-excavated channel through the coal-bearing strata, these strata are tilted by their proximity to Wet Mountain at quite a high angle, so that the dip of Coal F is east-northeast 40½°. Immediately underlying this coal is a layer of brownish shale, containing plentiful fragments of dicotyledonous wood.

Coal G, which is opened by a slight working, appears friable and of inferior promise.

SOME ACCOUNT, CRITICAL, DESCRIPTIVE, AND HISTORICAL, OF ZAPUS HUDSONIUS.

BY DR. ELLIOTT COUES, U. S. ARMY.

Having occasion to inspect specimens of this quadruped, collected under the direction of Professor Hayden, I have been led into a further investigation of the species, and have examined the whole of the material contained in the National Museum, Smithsonian Institution, as well as a considerable portion of the literature bearing upon the subject. The present brief article, sketched with pleasure at Professor Hayden's request, is incidental to three main points determined, namely :—

I. There is at present only one known species of *Zapus*.

II. The animal, usually referred to the *Muridæ*, differs from the *Muridæ* to a degree warranting the recognition of a family *Zapodidæ*. Such appreciation of the characters afforded was made in 1872 by Dr. Gill, who erected a family (*Jaculidæ*) for its reception. I may here allude to the presence of an upper premolar, not found in *Muridæ* proper; the different and peculiar construction of the anteorbital foramen; and the saltatorial development of the hind limbs. These and other characters are amplified beyond.

III. None of the various generic names which have been applied to *Zapus hudsonius* are tenable according to recognized rules of nomenclature. Of these, *Dipus* and *Gerbillus* are too obviously inapplicable to require comment. *Jaculus* of Wagler (1830) belongs here; but the name had been used before in an entirely different connection. *Meriones* is in similar case; its original application by Illiger was to another type. Though it was subsequently transferred by Frédéric Cuvier to the present animal (Illiger's being already provided with a name), it cannot stand in this connection; for no synonym of one genus shall become the tenable name of another. A new name, therefore, being required, *Zapus** is proposed; the introduction of the term, of course, necessitating coresponding change in the appellation of the family.

FAMILY ZAPODIDÆ.

< *Subfamily Dipodinæ*, BAIRD, M. N. A. 1857, 428.
= *Family Jaculidæ*, GILL, Arrangement of the Families of Mammals, 1872, 20.

GENUS ZAPUS, Coues. (*g. n.*)

Dipus, sp.; *Gerbillus*, sp., ALIQ.
Meriones, F. CUVIER, Dents des Mammifères, 1825 ?, p. —.—AUDUBON & BACHMAN, Q N. A. ii, 1851, 251. *Not of Illiger*, 1811.
Jaculus, WAGLER, Syst. Amph. 1839, 30.—BAIRD, M. N. A. 1857, 429. *Not of Jarocki.*

* Etym. *Za*, augmentative particle, and πους, pes.—This very pat name was suggested to the writer by Dr. Gill, who, however, considers the name *Meriones* to be tenable for this genus.

ZAPUS HUDSONIUS, Coues.

Synonymy.

Dipus hudsonius, ZIMMERMANN, Geog. Gesch. ii, 1780, 358, No. 268 (based on the Long Legged Mouse of Hudson's Bay, of Pennant).
BODDÆRT, Elench. Anim. i, 1784, 115 (based on Zimmermann).
"SCHREBER, Säug. , 861, No. 6."
FISCHER, Syn. Mamm. 1829, 340 (based on Zimmermann).
Gerbillus hudsonius, RAFINESQUE, Am. Month. Mag. 1818, 446.
LESSON, Man. i, 1827, 257.
Meriones hudsonicus, AUDUBON & BACHMAN, Q. N. A. ii, 1851, 251, pl. 85.
Jaculus hudsonius, BAIRD, M. N. A. 1857, 430, pl. 21, f. 5 *a–e*.
NEWBERRY, P. R. R. Rep. vi, 1857, 59 (California).
BAIRD, P. R. R. Rep. x, 1859, Gunnison's & Beckwith's Routes, Mamm. p. 8.
COOPER & SUCKLEY, Nat. Hist. Wash. Terr. 1860, 83, 101, 127.
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SAMUELS, Ninth Ann. Rep. Mass. Board Agric. 1862, 178 (habits).
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ALLEN, Bull. Mus. Comp. Zool. i, 1870, 226 (Massachusetts).
TENNEY, Am. Nat. vi, 1872, 330, f. 101 (habits).
MERRIAM, U. S. Geol. Surv. Terr. 1872, 665.
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Mus canadensis, "PENNANT" (mere Latin rendering of "Canada rat"?).
Dipus canadensis, DAVIES, Trans. Linn. Soc. iv, 1798, 155, pl. 8, f. 5, 6 ("Jumping Mouse of Canada").
SHAW, Gen. Zool. ii, 1801, 192, pl. 161 (after Davies).
TURTON, Syst. Nat. i, 1806, 100.
ORD, Guthrie's Geog. 2d Am. ed. 1815, 292.
FISCHER, Syn. Mamm. 1829, 339.
Gerbillus canadensis, DESMAREST, Mamm. ii, 1822, 331.
HARLAN, Fn. Amer. 1825, 155.
GODMAN, Am. Nat. Hist. ii, 1st ed. 1826, p.—; 2d ed. 1831, 94, pl. —; 3d ed. 1861, 94.
GRIFFITH, Anim. Kingd. v, 1827, 240, No. 624.
EMMONS, Mass. Rep. 1840, 69.
THOMPSON, Nat. Hist. Vermont, 1853, 44.
HALL, Canad. Nat. & Geol. vi, 1861, 304 (Montreal).
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SCHINZ, Syn. Mamm. ii, 1845, 91.
Dipus americanus, BARTON, Amer. Philos. Trans. iv, 1799, 115, pl. —; vi, 1804, 143.
ORD, Guthrie's Geog. 2d Am. ed. 1815, 292.
Jaculus americanus, WAGLER, Syst. Amphib. 1830, 23.
Meriones americanus, DEKAY, N. Y. Zool. i, 1842, 70, pl. 24, f. 2.
Dipus labradorius, TURTON, Syst. Nat. i, 1806, 99 (Labrador Rat of Pennant).
ORD, Guthrie's Geog. 2d Am. ed. 1815, 292.
Mus labradorius, J. SABINE, App. Frankl. Journ. 1823, 661.
Gerbillus labradorius, HARLAN, Fn. Amer. 1825, 157 (after Sabine).
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GRIFFITH, Anim. Kingd. v, 1827, 240, No. 625.
Dipus labradoricus, FISCHER, Syn. Mamm. 1829, 338.
Meriones labradorius, RICHARDSON, F. B.-A. i, 1829, 144, pl. 7.
WAGNER, Suppl. Schreb. iv, —, pl. 226 B (after Richardson).
DAWSON, Edinb. N. Philos. Journ. 1856, 2.
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Gerbillus sylvaticus, "MITCHILL." descr. nulla.
Meriones nemoralis, IS. GEOFFROY, "Dict. Class. vii, 323; pl. fasc. 10, n. 2."
Gerbillus daviesii, RAFINESQUE, "Préc. Découv. Sémiol. 14."
? Gerbillus soricinus, RAFINESQUE, "Préc. Découv. Sémiol. 14."
DESMAREST, Mamm. ii, 1822, 322 (compiled from Rafinesque).
LESSON, Man. i, 1827, 257 (compiled from Rafinesque).
? Dipus soricinus, FISCHER, Syn. Mamm. 1829, 339 (compiled from Rafinesque).

? *Gerbillus leonurus*, RAFINESQUE, Am. Month. Mag. 1818, 446.
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? *Dipus leonurus*, FISCHER, Syn. 1829, 339 (compiled from Rafinesque).
? *Gerbillus megalops*, RAFINESQUE, Am. Month. Mag. 1818, 446.
DESMAREST, Mamm. ii, 1822, 322 (compiled from Rafinesque).
LESSON, Man. i, 1827, 257 (compiled from Rafinesque).
? *Dipus megalops*, FISCHER, Syn. 1829, 340 (compiled from Rafinesque).
? *Gerbillus macrourus*, RAFINESQUE.
? *Gerbillus brachyurus*, RAFINESQUE.
Meriones microcephalus, HARLAN, Proc. Zool. Soc. Lond. vii, 1839, 1.
SCHINZ, Syn. Mamm. ii, 1845, 92 (compiled from Harlan).
Meriones acadicus, DAWSON, Edinb. N. Philos. Journ. iii, 1856, 2, pl. 1.
Canada Rat, PENNANT, Quad. ii, , 172.
Labrador Rat, PENNANT, Hist. Quad. 1781, 435, No. 295; Arct. Zool. i, 1784, 132, No. 63.
Jumping Mouse of Canada, DAVIES, *l. c.*
Labrador or Jumping Mouse, GODMAN, *l. c.*
Canadian Jerboa, SHAW, *l. c.*
Labradore Jerboa, TURTON, *l. c.*
Canadian and Labrador Gerbil, GRIFFITH, *l. c.*
Deer Mouse, DEKAY, *l. c.*
Gerbille du Canada, DESMAREST, *l. c.*
Mérione du Canada, LESSON, *l. c.*
Gerbille soricine, de la bäie d'Hudson, queue de lion, et aux yeux noirs, LESS., *l. c.*
Canadische, Labradorische, Kleinköpfige Hüpfmaus, SCHINZ, *l. c.*

Description.

Cranial and dental characters.—In comparison with the murine forms with which it has been associated, this animal presents many strong peculiarities of the skull and teeth. Among these may be enumerated the presence of an additional tooth in the upper molar series, causing an inequality in the formulæ of the two jaws; the size and shape of the anteorbital foramen, with its supplementary foramen or nick just beneath; the extension of the malar bone up the slender styloid zygomatic portion of the maxillary till it sutures with the lachrymal, and the slenderness and depression of the rest of the zygomatic arch; the shortness and transverse position of the bullæ auditoriæ; the position of the maxillo-palatine suture; expansion of the posterior nares, &c. The skull, as a whole, is shorter for its width, though the zygomata are even more nearly parallel; it is also deeper for its other dimensions, with a greater degree of convexity, both lengthwise and crosswise, of the superior contour. Nevertheless, its general superficial resemblance, aside from details, to that of *Mus* proper, is evident. Compared with that of *Mus musculus*, which is of about the same size, we see in each species the same general shape and delicate papery condition, without strong angularity, as well as many close coincidences in detail, indicating that the murine affinities of the family are with typical *Mus*, *Hesperomys*, &c., and not with the arvicoline group of *Muridæ*, in which the skull is notably heavier, more massive, and angular.

As to the general shape of the skull, there is little to be added to the foregoing, except such points as, being equally applicable to the familiar *Mus musculus*, need not be recapitulated; we may therefore at once proceed to details.

The anteorbital foramen, which transmits the masseter in this instance, and which constitutes a prime peculiarity of the skull, is of great size and obliquely oval in shape. Instead of being circumscribed by a plate of bone, as in *Muridæ*, it is defined externally by a very slender styloid process of the maxillary, which is strengthened by the upward extension of the malar, applied as a splint along its whole length. Below this main foramen there is another much smaller one, which transmits the

nerve. It is sometimes a complete foramen, separate from the other; sometimes only a deep notch in the lower border of the main opening; and this difference may be observed on the two sides of the same skull. I am ready to believe that this lesser opening, giving passage to the superior maxillary nerve, is the true "anteorbital" foramen itself; for it seems to correspond to the lower part of the large slit in *Muridæ*, which is walled in by the maxillary lamina, and it is formed by a little plate of bone, which rises as a ridge from the alveolar portion of the jaw, and bends over to abut against the main wall of the maxillary. In cases in which this plate fails to reach the main wall of the maxillary, so that only a notch and not a foramen results, the correspondence of the whole opening with the pyriform slit of the *Muridæ* is very evident, and the relation of the parts is fully established, though the shape is quite different.

The contour of the parts surrounding the foramen is such, that the zygomatic process of the maxillary stands out from the bone at right angles at a point scarcely above the level of the alveoli. The anterior root of the zygoma is hence notably depressed in position; there being no forward-upward reach of the lower border of this arch, so evident in *Muridæ*. The zygoma, in fact, is nearly horizontal in all of its length along the under side; but anteriorly the upper edge rises prominently, in consequence of the unusual extension of the malar up the maxillary, already mentioned. The malar runs all the way up to the lachrymal bone, affording a circumstance I have not seen elsewhere, and which I believe to be very rare, namely, a lachrymo-malar suture. This ascending spur of the malar is, moreover, expanded into a rather broad lamina, partly defending the orbit, thus supplying a wall that, in most cases, is afforded by expansion of the zygomatic process of the maxillary; the latter being in this case of styloid character. In its continuity, the malar is a slender rod; behind, it underlaps a short spur of the squamosal with simple squamous suture.

The general shape of the orbit is much the same as in *Mus*. In both, the squamosal forms much of the posterior orbital wall; the orbito-sphenoid being correspondingly reduced. The antero-exterior corner of the parietal reaches to the brim of the orbit.

The rostral portion of the skull bears to the rest about the same proportion as in *Mus*, and is equally attenuate anteriorly, though thicker at the base, and consequently more tapering. The ends of the nasals project conspicuously beyond the plane of the incisors; behind, these bones terminate opposite the ends of the intermaxillaries; the suture of the frontal with each of them, as well as with the maxillaries, being nearly in one transverse jagged line. The intermaxillaries develop a strong alveolar plate, separating the superior incisors for nearly half their length; this, with the projection of the nasals and backward set of the much-curved teeth, results in a snout strikingly like that of the *Saccomyidæ*. The feeble retreating under jaw, densely hairy upper lip, and small nasal pads, bear out this resemblance in the external physiognomy.

As in *Mus*, the interorbital constriction is moderate, being about as wide as the rostrum at base; and there is no trace of postorbital processes. The parietals are nearly square, though somewhat emarginate in front, to correspond with the convexity of the frontal. There is little, if any, dipping-down of a postero-exterior angle, so well exhibited in *Mus*. The interparietal is of a large size transversely, though narrow in the other direction; it reaches across the whole width of the combined parietals, bounding them both posteriorly, as it is itself bounded

by the occipital. The extent of this narrowly elliptical transverse interparietal is greater than in *Mus;* its corner is at a point where the back outer angle of the parietal, back upper angle of the squamosal, and front upper angle of the occipital all come nearly together. The squamosal closely resembles that of *Mus* in size, shape, and connections; there are the same extensive vacuities about the petrosal, with a similar strong clasp, bridging over the opening just above the meatus, running from the root of the zygomatic process to the back edge of the bone. The mastoid is of moderate size, developing nothing to be fairly called a process, wedged between the paroccipital process and the squamosal, at the postero-lateral corner of the skull. It is confluent with the petrosal, but partially fissured away from the surrounding occipital elements. The supraoccipital is of large size and convex contour; the occipital crest is slight, so that the plane of the occiput is not well defined from that of the superior surface of the skull, the two meeting with a continuous curve, more convex than in *Mus.* The upper border of the occipital is nearly straight, and bounded quite across by the interparietal; next comes a considerable piece of squamosal suture, and then the mastoid. The foramen is of great size and nearly hexagonal shape; most of it being in the one plane of the occiput, with only a slight nick inferiorly. The condyles are protuberant and convergent; the condyloid foramen is close beneath their articular surfaces. The paroccipital are well-marked vertical processes. The basioccipital narrows very rapidly, owing to the strong inward trend of the petrosals, and ends by transverse suture, as usual, with the basisphenoid, opposite the ends of these bones. Its under surface shows a pair of slight depressions, with a median ridge.

The posterior nares are of ample dimensions, owing to the wide separation of the pterygoids. These bones are long, straight, and styloid, with a slightly-clubbed extremity in close approximation to the ends of the petrosals. The palate ends behind with a broad, rounded emargination opposite the last molars. This formation is very different from that of *Mus*, in which the bony palate extends back of the molar series, and the contracted interpterygoid space is narrowly angular. The maxillo-palatine suture of *Zapus*, likewise, is differently located, being opposite the interspace between the penultimate and preceding molar, instead of much farther back. There is a pair of conspicuous palatal foramina opposite the penultimate molar. The contour of the palate differs from that of *Mus*, and perhaps a majority of allied rodents, in being broader in front than behind. The incisive foramina are of great length, as well as quite broad, reaching from little behind the incisors to opposite the molars; the perforation is half in the intermaxillary, half in the maxillary; the bony septum is bullous except at its posterior part.

The form of the descending process of the mandible is a strong character of *Zapus* in comparison with *Mus*, &c., in which this plate of bone is more or less squarish, and vertical or nearly so. In *Zapus*, the same plate is strongly twisted out of the axis of the jaw, standing diagonally outward and upward—very much, in fact, as witnessed in the *Saccomyidæ.* The coronoid is rather weak, falcate, acute, with a strong slope; it slightly overtops the condyle. The latter sets strongly backward, though it is rather more erect than in *Mus.* The incisor causes a moderate protuberance outside, at the root of the condylar process. Inside, nearly opposite, is the conspicuous foramen of the inferior maxillary nerve.

The superior incisors are short and stout, with a strong curve; their anterior faces strongly sulcate, with the outer half of the tooth rabbeted down so that the groove is plainly visible from the side. The inferior incisors are not specially noteworthy. The molar series differs from

that in *Muridæ* proper in the presence of a small anterior molar (premolar) in the upper jaw, with no tooth to correspond in the lower series. The minute premolar is single-rooted; the three following teeth have three roots apiece—a lengthwise pair of slender fangs outside, and a single stout fang, apparently formed of two coalesced roots, inside. The lower molars have each a pair of roots, in single lengthwise series. The anterior upper molar is the smallest of the whole, and simply circular; the next two are about equal in size; the last is much smaller. A similar proportion is seen in the under series. The pattern of the molar crowns is much complicated.

External characters.—A general murine form is modified by the great development of the hind limbs (much as in *Dipodidæ* or some forms of *Saccomyidæ*), and especially of the pes itself; an unusual length of tail, which greatly exceeds that of the body; a peculiar condition of the external ear; and a physiognomy quite like that of the *Saccomyidæ*. There are also well-developed internal cheek-pouches, shared in a less degree, however, by various American *Muridæ*.* These pouches, as well as can be judged from alcoholic specimens, are relatively about as large as those of *Tamias* for instance.

The body of *Zapus* is large behind, in correlation with the greatly-developed posterior limbs, and tapers to the fore in a regular manner; the head being comparatively small, and there being no noticeable constriction of the neck. The head is conoidal, with a prominent and rather blunt snout and retreating under jaw. The rather small eye is midway between the nose and ear. The upper lip is not visibly cleft, and is densely hirsute, with a fringe of hairs depending over and almost hiding the small front teeth. The naked muffle is of rather small size, and entirely inferior in position; above it, the hairy skin crosses with a deep transverse crease, forming a sort of imperfect overhanging flap, which is freely movable back and forth, even in alcoholic specimens, and looks as if it might be drawn down to partially cover the nostrils. (I have observed much the same thing in *Saccomyidæ*.) The nose-pad is impressed with a pair of median vertical grooves, and a transverse one is seen in some cases. The nostrils are completely lateral in position. The whiskers are rather sparse, but some of them are nearly half as long as the body.

The structure of the external ear is rather remarkable (among rodents) for the provision for perfect closure of the meatus, as in the *Soricidæ* for instance. The antitragus develops into a great flap, completely reversible, and capable of being applied against the meatus; and such, in fact, appears to be its usual position. The tragus, likewise, expands into a wide frill, or thin, free, rounded border, which ordinarily lies in apposition to the antitragal lobe opposite, completing the closure of the ear. On turning over these two flaps, the vestibule of the ear is seen to be of unusually large dimensions. The conch itself is of an ordinary contour, coming to a blunt point above; the anterior third is folded close back. The back of the ear and the fold of the conch are sparsely pilous; the

*The presence of cheek-pouches in the genus *Hesperomys* was first noted in 1830 by Gapper, who referred specimens of the common *Hesperomys leucopus* to *Cricetus* on this account, establishing a species *C. myoides*. In this matter, he was succeeded by Baird in 1857, who also recognized the pouches, and endorsed a *Hesperomys myoides* mainly upon this feature, failing, however, to observe that they also existed in other species of the same genus. At the same time that Mr. J. A. Allen announced the before unknown pouches of *Zapus hudsonius*, he also showed that they occurred as well in various species of *Hesperomys;* and my subsequent dissections have satisfied me that pouches are present in all the North American species of *Hesperomys* proper; *i. e.*, the subgenus *Vesperimus* as established by me; Proc. Acad. Nat. Sci. Phila., 1874, 178.

exposed parts of the front of the ear being more thickly clothed. The antitragal pad bears on its outer surface a special tuft of long hairs; its other side being naked, as are both sides of the flap of the tragus.

The fore limbs are absolutely small as well as short relatively to the hinder ones; and they seem to be placed rather far forward, though this appearance may be due, in part at least, to the tapering shape of the body. The hands are pilous above, naked below. There are four perfect fingers, with ordinary claws, and a rudimentary thumb, which bears a flat, blunt nail. The third digit is the longest; the fourth, second, and fifth being successively shortened. The digits are regularly transversely scutellate below. The palm is granular throughout, with a pair of large smooth pads (inner and outer) near the wrist, and three smaller tubercles at the base of, respectively, the second, the fifth, and the conjoined third and fourth digits.

The elongation of the hind limbs, which confers the high degree of saltatorial power upon this animal, like that of *Dipus*, &c., to which it has been referred, is especially noticeable in the pes, which exceeds the crus in length. This development of the foot, nevertheless, is not accompanied by reduction of the digits in number, nor by any imperfection of their respective metatarsals. The number of these bones has been queried; I find five, perfect from end to end, with complete tarsal and phalangeal articulations. The foot is clothed above with short, soft, silky hairs, quite different from the hirsute pelage of the body; below it is entirely naked, though the lateral fringe of hairs encroaches upon the contracted heel. The sole is perfectly smooth (as in *Mus*) for about half-way, then granular; the digits are transversely scutellate underneath. There is a well-defined tubercle on the inner side a little distance above the base of the first digit, and four others at the bases of, respectively, the first, second, fifth, and conjointed third and fourth digits. There are five perfect and normally-clawed digits. The first is shortest, and also situated rather high up, so that its tip reaches only to about the base of the second. The fifth is next longer, reaching the middle of the fourth. The third slightly exceeds the fourth and second, which are about equal to each other. There is much basal webbing between the three intermediate digits—especially between the third and fourth—which carries their apparent bases far beyond the bases of the lateral digits.

In its relative length, the tail exceeds that of any other North American (mammal?) rodent, always greatly exceeding the head and body, and sometimes measuring nearly twice as much. It is cylindrical, with uniform taper and very slight caliber, coming to a fine point with a slight pencil of hairs. Its hairiness is about on a par with that of *Mus musculus*, *decumanus*, &c.; that is to say, insufficient to hide the verticillate whorls of scales between which the short hairs spring.

The general pelage of this animal is coarse and hispid, with little gloss, and presenting a streaky or "staring" appearance, owing to the number of bristly hairs which are mixed with the softer under fur. The color varies a good deal in different specimens, though one pattern is pretty constantly preserved. About one-third of the colored part of the fur—that is to say, a dorsal strip about as wide as the lateral strip on either side—is brownish-yellow, heavily shaded with brownish-black. The sides, with the outer surface of the limbs, are of this same sandy-yellowish, but so slightly lined with the blackish that the purity of the light color is scarcely interfered with. The under parts are snow-white, with a pretty sharp line of demarcation from the colored areas. The backs of the hands and feet are whitish. The tail is rather indistinctly

bicolor, to correspond with the body-areas—dark-brown above, whitish below. The ears have a light-colored rim. The whiskers are mostly black. The basal part of the fur, in the colored areas, is gray or plumbeous, excepting just along the line of junction of the tawny of the sides with the white of the belly, where the hairs are white to the roots, like those of the belly. To this absence of dark bases of the hairs is due the appearance of a fulvous stripe along the sides, sometimes quite strongly marked, much as in species of *Perognathus* or *Cricetodipus*. In these cases there are thus four styles of coloration from back to belly: the dark dorsal area, mixed blackish and sandy, with plumbeous roots; sandy, with little or no blackish, but still with gray roots; sandy, with white roots; and finally pure white. The variations to which the species is subject lie in the brightness or dullness of the tawny, and its lining with a varying amount of blackish; the degree of distinctness of the dorsal area from that of the sides, and of this from the white of the belly; and in the sharpness or indistinctness of the tawny lateral stripe along which the hairs are white at the roots. The line of the belly-white is pretty constantly sharp, as in *Hesperomys;* but there is often a very gradual shading from the dark dorsal area to the tawny of the sides, and the latter is sometimes very pale yellowish-gray, &c. I have observed no plumbeous or entirely gray stage like that of young *Hesperomys* in general; and I have failed to determine what definite relation, if any, the observable differences in coloration bear to sex or age.

The animal varies much in size, and to some extent in proportions, especially the length of the tail. This is the most variable dimension, as usual in all such cases of high development of parts. A tendency to superior size in specimens from the Rocky Mountains and westward has been noted. The following table of measurements of an alcoholic series indicates very fairly the dimensions, and, to some extent, the variations, in size and proportions:

Measurements of twenty-one alcoholic specimens (English inch and decimals).

National Museum No.	Locality.	From tip of nose to—				Tail—	Length of—	
		Eye.	Ear.	Occiput.	Tail.	Vertebræ.	Fore foot.	Hind foot.
2592	Halifax, N. S	0.45	0.80	1.00	2.75	5.00	0.40	1.20
2393	Middleboro', Mass	0.42	0.75	1.00	2.90	5.25	0.35	1.18
2395	......do	0.45	0.90	1.00	3.00	5.00	0.37	1.20
2396	......do	0.42	0.80	0.95	2.75	4.50	0.45	1.18
2397	......do	0.40	0.80	0.95	3.00	5.30	......	......
2398	......do	0.43	0.85	1.00	2.75	4.75	0.35	1.15
2594	Burlington, Vt	0.45	0.90	1.00	3.30	5.35	0.40	1.18
2599	Wethersfield, Conn	0.45	0.90	1.00	2.75	4.80	0.40	1.10
2600	......do	0.45	0.80	1.00	2.75	4.35	0.35	1.15
2605	Waterville, N. Y	0.45	0.90	1.10	3.10	4.95	0.45	1.15
2606	......do	0.50	0.95	1.00	3.25	5.00	......	......
2607	......do	0.45	0.85	1.00	2.85	4.90	0.40	1.15
2608	......do	0.45	0.90	1.00	3.00	5.00	0.40	1.15
2604	Philadelphia, Pa	0.45	0.85	1.00	2.90	4.65	0.45	1.13
2601	Carlisle, Pa	0.45	0.85	1.00	2.85	4.50	0.45	1.15
2602	......do	0.45	0.85	1.00	2.85	4.75	0.45	1.15
2603	......do	0.40	0.80	0.95	2.60	4.40	0.40	1.05
2611	West Northfield, Ill	0.40	0.80	0.90	2.80	4.70	0.40	1.10
2610	Upper Missouri	0.50	1.00	1.15	3.00	5.10	0.48	1.15
1929	Platte River, Nebr	0.40	0.80	0.95	2.75	4.50	0.45	1.12
2609	Steilacoom, W. T	0.45	1.00	......	......	6.10	0.50	1.35
	Average	0.44	0.86	0.99	2.89	4.90	0.42	1.15

Skulls measure from 0.90 to 1.00 by 0.45 to 0.50.

Geographical Distribution.

The dispersion of *Zapus hudsonius* in North America can at present be given only in somewhat general terms, pending precise information respecting both northern and southern limits of its distribution. It inhabits the greater part of British America and the United States, from ocean to ocean. The northernmost recorded locality we have noted is Great Slave Lake, latitude 62°; and the southernmost is Virginia, where we have ourselves observed it. It was originally described from Hudson's Bay, Labrador, and Canada, and appears to be particularly numerous in the last-named region and northern half of the United States. Audubon surmises, with much reason, that it exists south of Virginia, at least in mountainous regions; while there is no doubt of its presence in elevated portions of Arizona and New Mexico, which harbor such a truly boreal animal as *Gulo luscus*. We have found it in Dakota, and it is known to exist on the Pacific coast, in Washington Territory; while the moist and comparatively warm climate of the wooded region, thence northward, we may properly surmise, will carry its habitat far into Alaska. Its dispersion will probably ultimately prove to be little, if any, less extensive than that of *Hesperomys leucopus;* although, as it is more strictly a woodland animal, there are large treeless areas within its general range where probably it does not occur.

History.

The latter part of the last century gave us our early accounts of this animal under four different names, from three distinct sources—Pennant, Davies, and Barton. Thomas Pennant appears to have first described it under the name of the "Long-legged Mouse of Hudson's Bay", whence comes the first technical appellation *Dipus hudsonius*, conferred by Zimmermann in 1780. Pennant also had a "Labrador Rat", the description of which applies perfectly to the present species; and, furthermore, a "Canada Jerboid Rat", failing to recognize the fact that all three were the same. Pennant further erred in hastily identifying the animal sent from Hudson's Bay by Mr. Graham with the *Mus longipes* of Pallas, or *Dipus meridianus* of Gmelin, an Asiatic quadruped. Pennant's three animals became the bases of as many technical names—*hudsonius*, *labradorius*, and *canadensis*—the last of these at the hands of General Davies, who, in 1797 or 1798, communicated to the Linnæan Society "an account of the Jumping Mouse of Canada (*Dipus canadensis*)", which was published in the Transactions of that body for 1798, as above cited, accompanied by figures. General Davies gave a fair account of the animal, which was copied into Dr. G. Shaw's General Zoology, with the figures representing the creature in activity and repose. These cuts, though now seeming very rude, are quite characteristic and unmistakable. Joseph Sabine is currently accredited with the authorship of the term *Mus labradorius*, based upon Pennant's Labrador Rat; but a *Dipus labradorius* had already appeared in 1806 in Turton's English version, with compiled additions, of the Linn.-Gmelinian Systema Naturæ. Meanwhile, the third independent source of information, following Pennant and Davies, had appeared in 1799, when Prof. Benjamin S. Barton gave "some account of an American species of Dipus or Jerboa", and named the animal *Dipus americanus* in the Transactions of the American Philosophical Society, as above cited. This seems to have been the earliest reference to the animal as an inhabitant of the United States; and the name was given in ignorance of the earlier accounts from British

America. Such, however, was not the case with the two later synonyms we have adduced. After treating of "*Gerbillus labradorius*" from fair acquaintance in 1825, Dr. Harlan, in 1839, described specimens from Philadelphia as a new species, under the designation of *Meriones microcephalus;* while, still later, Nova Scotian examples received from Principal Dawson the appellation of *Meriones acadicus*. But the characters adduced by both of these authors fail to indicate anything tangible; and it is certain that if more than one species of *Zapus* inhabits North America, it remains to be discovered; for the several queer animals of this kind indicated about the year 1817 by M. Rafinesque, under the names of Short-tailed, Long-tailed, Lion-tailed, Shrew-like, and Big-eyed, are undoubtedly figments of that author's fertile imagination. We quote these names with a query, together with the compiled accounts that go with them, merely observing that, if they do not belong to *Zapus hudsonius*, they certainly belong nowhere else. To give credit where it is due, however, we should not omit to add that, besides these five "new species" of "Gerbillus", M. Rafinesque furnishes us with two others—*G. daviesii*, which is merely another name for Davies's *Dipus canadensis*, and *G. hudsonius*, in presenting which last he has the credit of leading the adoption of the specific name which has priority, and which must unquestionably be adopted. Recurring once again for a moment to the earlier dates in the history of the species, we find a name *Gerbillus sylvaticus*, imposed by Mitchill, but without an accompanying description; and still another, said to have been given by Isidore Geoffroy in the seventh volume of the Dictionnaire Classique—*Meriones nemoralis.*

It would appear, from the foregoing sketch of its history, that this animal was already quite sufficiently named; but this is only a consideration of its specific appellations, without reference to the various generic terms by which it has been designated by authors, nearly all of whom seem determined to make it out to be some kind of a Jerboa, because of its powers of leaping. But nothing is more certain than that it is not generically related to any of the *Dipodidæ*. It has usually been placed at least in a subfamily *Dipodinæ*. The family value of its characters were only lately recognized, when, in 1872, Dr. Gill constituted a family *Jaculidæ*, overlooking the fact, as Professor Baird had also done, that the name *Jaculus* was pre-occcupied in another connection.

ON THE BREEDING-HABITS, NEST, AND EGGS, OF THE WHITE-TAILED PTARMIGAN (LAGOPUS LEUCURUS).

By Dr. Elliott Coues, U. S. Army.

Very little having been placed on record respecting the breeding-habits, nest, and eggs of *Lagopus leucurus*, the present occasion is taken to bring together the information we possess on the subject, and supplement it with a more precise account, the result of an examination of a set of eggs which, with the nest, were collected during the summer of 1875 by one of Dr. Hayden's parties, and submitted to my inspection.

The White-tailed Ptarmigan is interesting as the southernmost species of the genus *Lagopus*, and the only one of any considerable latitudinal dispersion in the United States. The Willow Ptarmigan (*L. albus*) is indeed recorded from some points along our northern frontier, but even there its occurrence has only been noted in winter. *L. leucurus* alone breeds within the United States (exclusive of Alaska). It is one of the later additions to the genus, having remained unknown to naturalists up to the year 1831, when it was described and figured by Swainson and Richardson in the second volume of the *Fauna Boreali-Americana* (p. 356, pl. 63), from six specimens procured by Mr. Drummond and Mr. Macpherson in the Rocky Mountains, latitude 54° to 63° north. Mr. David Douglas had killed several in 1827, but these were destroyed. It is only within the last few years that we have become fairly well acquainted with the bird. The species is readily distinguished from its allies by the character implied in the name; the tail-feathers being pure white, like the rest of the plumage in winter.

Its known range in the United States has lately been extended to latitude 37° north; the species having been found at Cantonment Burgwyn, New Mexico, by Dr. B. J. D. Irwin, United States Army.* In longitudinal distribution, it is confined to the Rocky Mountains and some other high ranges in the West.

The earliest account of the nest or eggs which I have at hand is that given by Mr. C. E. Aiken,† who states that the bird is said to be common on the Snowy Range of Colorado Territory, and who describes the nest, upon the authority of a miner, as composed of leaves and grass, upon the ground, among bushes. The eggs in this case were said to have been fourteen in number, and "light bluish-brown, spotted with dark-brown," in color.

The first egg known to me to have been examined by a naturalist was an imperfect one taken by Mr. A. G. Mead, who procured it on Mount Lincoln, Colorado Territory, and by him presented to Mr. J. A. Allen, who kindly furnished me a short description, which I published in the account of the species given in the "Birds of the Northwest" (p. 426). According to Mr. Allen, it was "thickly sprinkled with small, bright

* Coues, Proc. Acad. Nat. Sci. Phila. 1866, p. 94.
† Proc. Bost. Soc. Nat. Hist. xv, 1872, p. 209.

reddish-brown dots, on a chocolate-colored ground, and measured about 2.00 inches in length by 1.20 inches in diameter". This same egg was also described by Dr. T. M. Brewer, in Baird, Brewer, and Ridgway, History of North American Birds, iii, 1874, p. 465.

The first account of the particular habits of the bird during the breeding-season was likewise communicated to me by another esteemed correspondent, Mr. T. Martin Trippe, C. E., who appears to have enjoyed excellent opportunities for observation among the mountains of Clear Creek County, Colorado Territory. "The Ptarmigan builds its nest," says Mr. Trippe, "in the latter part of June, and commences hatching toward the close of the month or early in July. The nest—which is always on or near the summit of a ridge or spur, many hundred feet above timber-line—is merely a depression in the ground, lined with a few straws, and white feathers from the mother's breast. The eggs are eight in number, of a light buff-brown, thickly sprinkled with spots of dark chocolate-brown, somewhat thicker at the larger end. While on her nest, the bird is very tame. Once while walking near the summit of the range, I chanced to look down, and saw a Ptarmigan in the grass, at my very feet—at the next step I should have trodden upon her. Seeing that she did not appear frightened, I sat down gently, stroked her on the back, and finally, putting both hands beneath her, raised her gently off the nest and set her down on the grass, while she scolded and pecked at my hands like a setting hen, and, on being released, merely flew a few yards and settled on a rock, from which she watched me till I went away. Late in July, I came across a brood of young ones, apparently not more than four or five days old. They were striped with broad bands of white and blackish-brown, and looked precisely like little game chickens. The mother flew in my face and hit me with her wings, using all the little artifices that the Quail and Partridge know so well how to employ, to draw me away; while her brood, seven or eight in number, nimbly ran and hid themselves in the dense grass and among the stones. On another excursion above timber-line, toward the close of August, I found most of the young ones nearly grown and strong on the wing; but one brood was of the size of Quails, showing that some birds must begin breeding much later than others, or that they occasionally raise two broods."—(Birds of the Northwest, p. 427.)

In the Proceedings of the Boston Society of Natural History, vol. xvi, p. 348 (1874), Dr. T. M. Brewer describes the fragments of a set of eggs received from Mr. T. M. Trippe, whose MSS. notes accompanying, published by Dr. Brewer, are to the same effect as those already quoted from the "Birds of the Northwest"; having apparently been drawn up from the same incident. This set of eggs was found June 28, 1873, on a high ridge a thousand feet above timber-line, near the Chicago Lakes, about fifteen miles from Idaho Springs, Colorado Territory. One of the eggs, though much damaged, admitted of being put together sufficiently to show its size, shape, and in fact all its characters. It is thus described by Dr. Brewer: "This egg is 1.70 inches in length by 1.21 in breadth; is oval in shape, one end being but very little smaller than the other. The ground-color is a rich creamy-drab, and the surface of the egg is pretty uniformly marked with small rounded dots of dark chestnut; these are about equally distributed over the entire egg, and are nowhere confluent."

A further contribution to the history of the species was made by Mr. J. H. Batty in the *Forest and Stream* (newspaper) of January 29, 1874. The writer has, however, little to say of the breeding-habits, and, as is now clearly seen, was in error in his supposition that the bird lays only

three or four eggs, having reasoned upon insufficient premises, as well as in the face of all analogy bearing upon the reproduction of species in this family of birds.

The material which forms the especial subject of this article consists of a nest and four eggs.

I am not informed that this number of eggs is to be considered as the nest-complement; nor is there any reason to believe that the clutch, had it been completed, would not have consisted of a greater number.

The specimens were taken by Mr. A. D. Wilson, topographer of the Southwest Division of Dr. Hayden's Survey, on the 15th of July, 1875, in the Sierra San Juan, Southern Colorado, near the headwaters of the Rio Grande del Norte, eleven miles southwest of Antelope Park, on a rocky plateau, at an altitude of about 12,400 feet. They are deposited in the National Museum, Smithsonian Institution, being No. 17200, S. I. Register. The authentication and identification are absolute; and the specimens are the first perfect ones which have been seen in any collection—as far as the writer's information goes.

The nest, in its present state, measures scarcely five inches in diameter by about an inch in depth. It thus seems rather small for the size of the bird, but is probably somewhat compressed in transportation. The shape is saucer-like, but with very little concavity of surface. The bottom is decidedly and regularly convex in all directions, apparently fitting a considerable depression in the ground. The outline is, to all intents, circular. The nest is rather closely matted, the material interlacing in all directions, and retains considerable consistency. The material is chiefly fine dried grass-stems; with these are mixed, however, a few small leaves and weed-tops, and quite a number of feathers. The latter—evidently those of the parent birds—are embedded throughout the substance of the nest, though more numerous upon its surface, where a dozen or so are deposited; there may have been some loose ones lost in handling.

The account of the color of the eggs, given by Mr. Aiken upon impersonal authority as "light bluish-brown", is altogether wrong. Nor does the color of the specimens before me seem to my eye to agree with the expression used by Mr. Allen respecting his specimen—"chocolate-colored". Dr. Brewer's phrase—"rich creamy drab"—is just about the mark, though I hardly perceive a shade of the color to which I attach the name drab. However, "drab" and "dun" are indefinite terms. I should say, simply, that the ground is dull cream-color; and in selecting this term I have the advantage of the opinion of an expert colorist. The general complexion of the egg is very notably different from that of the eggs of either *L. albus* or *L. rupestris*, owing to the much fewer and smaller spots. In the species just mentioned, the markings are so strong and so numerous that they confer the general tone; and it is difficult to render an ordinary pen-and-ink stroke legible. In the present case of *L. leucurus*, the ground-color is as evident as the markings, and the inscription on the shell is perfectly plain.

The markings are all small, for the most part sharp and distinct,—the occasional overlapping of the spots producing in no case a blotch of any considerable size—mostly rounded in contour, to all intents distributed evenly over the whole surface, and, of course, innumerable in number. Very few of the spots exceed a large pin's head in magnitude; the more conspicuous ones are of about such size, while numberless others are dots or mere points. The color of all the markings is the same, though the larger ones seem of a slightly darker shade than the others, simply because the pigment is laid on more heavily. This

color is dark burnt-sienna, approaching to umber-brown. "Chocolate," "mahogany," "chestnut," are all more familiar terms, which might be used to suggest the color. The markings are all superficial—none appear to be overlaid by shell-substance.

In shape, these eggs are very perfectly ovoidal, without notable pointedness at the smaller end or special flatness at the other; the greatest diameter being nearly across the middle. Three of the specimens measure as follows (the fourth being defective at the point): No. 1, 1.70 × 1.15; No. 2, 1.70 × 1.14; No. 3, 1.68 × 1.11 (inches and decimals).

The shell is smooth to the touch. Seen under a strong lens (Tolles's ¼-inch triplet), the surface resembles polished marble, consisting of irregularly-shaped, smooth-edged prominences, betwixt which are innumerable small circular pits or pores.

BALTIMORE, *October* 16, 1875.

DEAR SIR: Permit me to express my thanks for your many courtesies extended to me while I have been engaged in the delicate task of discriminating the forms of *Hemiptera* acquired by your surveys. It has seemed important to have a complete list of all the described species belonging to the regions west of the Mississippi Valley, to enable the rapidly-increasing number of western students to become acquainted with the work that has been done by those who have preceded them, and to furnish the preliminary means for an accurate acquaintance with the forms of life essential to the various localities. Accordingly I have given here a summary, as complete as possible, of all the *Heteroptera* known to occur in those regions. I have also included descriptions of the new species which have been brought home by your expeditions. In each case, the synonymy, references, and habitats have been supplied as far as they are known.

A large amount of labor yet remains to be done in securing the genera and species characteristic of and illustrating each life area in this vast territory. And it is to your enlightened enterprise that we must look for the information and discriminating aggregation of the materials necessary for the proper understanding of their meaning and history. The present time, as you know so well, is peculiarly the proper one to make extensive collections of the insects, &c., of the great Rocky Mountain system and its dependencies. The present may be the only time when it will be possible to obtain the forms of life truly representative of the areas of distribution, either as to their local associations in the development of the locality in the recent period, or as forming an integral part of the geological past.

No sooner has the agency of man impressed itself upon the natural characteristics of the country, than a host of changes becomes perceptible, and features which were before clear and stable become indistinct, or are completely blotted out and lost beyond recovery. New forms of life are thus made to take the place of a former fauna, and the conditions of surrounding existence are bent to the artificial status of man's requirements.

The older parts of our country are to-day lamentable instances of the artificial stamp which man impresses upon wild nature. Destruction of the vegetation and of animal life takes place on every side; and instead of a harmonizing and softening of the rougher features of creation, we see a blotting-out and reckless change. By these unfortunate disturbances of the balance of representative peculiarities, it has become impossible, in some parts of our Eastern States, to know what were the original inhabitants of the natural areas, and what was their agency in determining some of the conditions of soil and surface which we observe to-day.

To show whence the present forms of life have been derived, both

vegetable and animal, what causes have brought in their present appearances and habits, and how they may be made subservient to the best uses of our people, render it necessary that large collections of specimens, including all their varieties, stages of life, and peculiarities, be amassed from all the varieties of surface, soil, water, and climatal or chemical areas.

Certain Rocky Mountain cañons and gorges which have been made wider and deeper by the forces of nature, present level, or nearly level, shelves, ridges, or plateaus, along the sides of the streams that dash through them; and the soil prepared there by the grinding floods and decaying mineral masses has fitted up an abode for numerous creatures which formerly could not live there. Other forms of life may have lasted through less locally energetic changes of soil and surface from a time that may date back far in some geological period of the past.

The presence of *Liburnia vittatifrons* (a salt-marsh form of the Atlantic border in the warm-temperate zone) upon low spots in the prairies of Illinois and Nebraska, may serve to show that these localities were once the beds of salt-lakes. And may we not at least surmise that the extent and boundaries of such, and of other formations of the past, may be nearly determined by a careful search for the facts of distribution of similar creatures.

Why is it that the Elkhorn Cactus affects the plains and foot-hills of Colorado south of the Divide, stopping almost suddenly in the vicinity of Piñon, and scarcely, if at all, appearing north of this place? Three of its allies, of less discrimination, extend over the whole length of the plains, north and south, throughout the Territory of Colorado.

The voracious grasshoppers, which come sweeping down from the mountain-heights upon the plains, although identical in species over hundreds of miles of territory, have well-marked races affecting different sections, which make it easy for the practiced eye to distinguish a southern form from one found farther north.

A species of large sunflower grows on the plains of Kansas and Colorado. In the latter State, it occurs in patches here and there, over a distance of at least three hundred miles. Upon this sunflower, in the valley of the Arkansas, lives abundantly the *Gnathium minimum*, Say; but north of this, the most rigid search failed to detect a specimen of it.

Instances of similar import might be mentioned without number. But I beg that you will pardon me for these few suggestions made in behalf of the demands of modern science, and to encourage those who are favorably situated to help in bringing together materials for a full history of the great region from which you have extracted so much that conduces to the prosperity of our great country.

Very respectfully, yours,

P. R. UHLER.

Dr. F. V. HAYDEN,
Chief of the U. S. Geological and
Geographical Survey of the Territories.

LIST OF HEMIPTERA OF THE REGION WEST OF THE MISSISSIPPI RIVER, INCLUDING THOSE COLLECTED DURING THE HAYDEN EXPLORATIONS OF 1873.

By P. R. Uhler.

Order HEMIPTERA.

Larva and nymph active, generally resembling the adult insect. Head set into the pronotum (in *Corisidæ* overlapping it anteriorly), provided with a stiff, jointed beak of three to four joints, inclosing four bristle-like sucking tubes. Wings four (entirely absent from a few species); the wing-covers either horizontal or declivous when at rest, generally opaque and thicker at base, with the apical portion membranous.

Suborder HETEROPTERA.

Rostrum attached beneath the anterior extremity of the head; the front generally situated superiorly; the hemelytra heteronomous, overlapping at tip.

Division GYMNOCERATA.

Antennæ free, not concealed beneath the head, 3- to 5-jointed (in a few 13-jointed). Legs adapted for creeping, running, leaping, balancing in flight, or for skimming over the surface of the water.

Superfamily SCUTELLEROIDEA.

Scutellum covering nearly the whole tergum; orbicular.

Family CORIMELÆNIDÆ.

Corimelæna, White.

1. *C. nitiduloides.*

Cimex nitiduloides, Wolff., Icones Cimicum, 98, pl. x, fig. 92.
Odontoscelis nitiduloides, H. Schf., Wanz. Ins. v, 12, tab. 149, fig. 47.
Corimelæna nitiduloides, Dallas, Brit. Mus. List Hemipt. i, 56, No. 2.

Obtained above timber-line in the mountains of Colorado, by Lieut. W. L. Carpenter. Although found at such a considerable altitude, it offers no important differences from the specimens common to Kansas, Texas, Missouri, and the Atlantic region.

2. *C. ciliata.* New sp.

Deep bluish-black, short and broad; margins of the head, pronotum, and abdomen ciliated with remote long hairs. Head large, broadly depressed in front; the anterior margin broadly rounded; punctures fine and close; the base almost impunctured; the edges narrowly recurved; antennæ rufo-piceous; rostrum reaching between the middle coxæ. Pronotum broad, not very convex; finely punctured; the punctures becoming deeper and denser at the sides; the lateral margins but moderately rounded; edges recurved; the surface a little uneven in places; intrahumeral impressions shallow, long; the posterior margin moderately elevated above the base of the scutellum. Scutellum moderately convex, not very high, broadly rounded; the sides near the base rather strongly, broadly sinuated; surface finely, distinctly punctured; the punctures coarser and denser each side at base. Corium moderately wide, very bluntly oblique at tip, closely punctured, except upon the inner margin, and with three impressed striæ, which are confluent at tip. Beneath finely punctured. Coxæ and legs rufo-piceous; tarsi yellowish.

Length, 5 millimeters. Breadth of pronotum, 3 millimeters.

Inhabits California (Dr. LeConte); San Francisco (James Behrens); Oregon (Dr. Horn).

3. *C. cyanea.* New sp.

Bright steel-blue, polished; in form similar to *C. ciliata.* Head broad, finely, densely, confluently punctured; each side faintly sinuated; the anterior margin and tylus very narrowly recurved; each side between the eye and ocellus is a short distinct sulcus; antennæ and rostrum piceous, the latter scarcely reaching the middle coxæ. Pronotum much broader than long, moderately convex; disk finely punctured, but each side of it coarsely punctured; humeri moderately high, a little produced backward; the adjoining impressions long, rather shallow, and with a single indistinct stria; the posterior margin but little higher than the scutellum. Scutellum a little purplish; each side of disk uneven and obsoletely ridged; punctures numerous, confluent each side and behind; the lateral edge moderately waved, a little sinuated at base. Corium broad, approximately bistriate, and, excepting the inner smooth margin, densely punctured. Pectus black, finely punctured. Venter finely, closely punctured, polished, steel-blue. Legs blue-black; tarsi testaceous.

Length, 5 millimeters. Width of pronotum, $3\frac{1}{4}$ millimeters.

Inhabits California (Dr. Horn); Arizona (J. Behrens).

4. *C. cœrulescens.*

Thyreocoris cœrulescens, Stål, Hemipt. Mex. Stettiner Ent. Zeit. xxiii, 94, No. 42.

Inhabits Mexico; Arizona (Dr. Horn); California (J. Behrens); Kansas; Colorado (J. Ridings).

5. *C. anthracina.* New sp.

Broad ovate, polished, intensely black, coarsely, in part confluently, deeply punctured; in form similar to *C. lateralis*, Fab. Head short, subtriangular, slightly convex, sinuated each side, subtruncated in front; surface coarsely, confluently punctured; the extreme base smooth and impunctured; tylus scarcely longer than the lateral lobes; lateral edges acute; antennæ pale rufo-piceous; the second joint less than one third as long as the third and not thicker than the slender base of that joint;

rostrum reaching to the posterior line of the intermediate coxæ. Pronotum symmetrically convex; the lateral margins obliquely arcuated; length a little more than one-half of the breadth of base; surface coarsely, closely punctured, here and there with minute punctures between, on the sides more coarsely, densely, and confluently punctured; on the base a little obsoletely punctured; posterior margin behind the sinus a little flattened; pectoral areas opaque black, confluently punctured; the meso- and metapleural pieces longitudinally wrinkled. Legs piceous-black; the femora obsoletely punctately-indented; tarsi testaceous. Scutellum short and broad, convex, bluntly rounded at tip; the sides at base contracted and sinuated, and bounded there by a smooth, slender frenum; the surface less densely and more obsoletely punctured than the pronotum, and still more finely and remotely at the apex; sides at base coarsely, densely, confluently punctured. Corium about two-thirds the length of the scutellum, of medium width, and blunt at tip, distinctly and not very coarsely punctured, more coarsely and closely at base. Venter convex, very highly polished, remotely and less distinctly punctured on the disk, but very distinctly, closely, and more coarsely so on the sides, and posteriorly. ♀.

Length, 4¾ millimeters. Width of pronotum, 3 millimeters.

Inhabits California (James Behrens).

6. *C. extensa.*

Corimelæna extensa, Uhler, Proc. Amer. Ent. Soc. 1863, 155.

Inhabits Dakota (Mr. Pearsall); Oregon and Arizona (Dr. Horn); California (J. Behrens).

7. *C. lateralis.*

Tetyra lateralis, Fab., Syst. Rhyng. 142, No. 68.
Odontoscelis lateralis, H. Schf., Wanz. Ins. v, tab. 149, fig. 473.
Corimelæna lateralis, Dallas, Brit. Mus. List Hemipt. i, 59, No. 11.

A single specimen of the variety with very narrow, pale costal margin, collected in Kansas, was given to me by Mr. H. Ulke. It abounds on the prairies of Illinois, and is common in Michigan, New York, Massachusetts, Rhode Island, Pennsylvania, and farther south. In Maryland, specimens sometimes occur which are destitute of the lateral pale margin; and near Baltimore may be found all the varieties between the extremes of color and punctuation.

8. *C. pulicaria.*

Odontoscelis pulicarius, Germar, Zeits. i, 39, No. 6.
Corimelæna pulicaria, Dallas, Brit. Mus. List Hemipt. i, 59, No. 10.

Inhabits Kansas, Dakota, Minnesota, and is distributed over the whole length of Atlantic North America from Quebec to Florida, and westward to Louisiana and Texas.

9. *C.? albipennis.*

Thyreocoris albipennis, Say, Heteropt. New Harmony, 2, No. 2.

"Oval, pale fulvous. Pronotum blackish before and on each side; the lateral margin white. Scutellum each side at base with a small black spot. Hemelytra white, with a small rufous spot. Beneath piceous; the lateral margins of the pectus white."

Length less than one-fifth of an inch.

Obtained by Mr. Say in Nebraska near the Missouri River.

The specimen described by Mr. Say was a mutilated one, without a head. It may not belong to the genus to which it is here referred; but as it has been placed by its describer in *Thyreocoris*, it must be at least somewhat related to the genus *Corimelæna.*

The description is copied here with a view to call the attention of collectors to this remarkable insect, and to enlist those who are favorably situated to endeavor to recover it for the advancement of our knowledge in this branch of modern science.

Family PACHYCORIDÆ.

Homœmus, Dallas.

1. *H. æneifrons.*

Scutellera æneifrons, Say, Long's Exped. appendix, 299, No. 2.
Pachycoris exilis, H. Schf., Wanz. Ins. iv, tab. 110, fig. 346.

Inhabits Colorado, and the Atlantic region generally from Canada to Virginia. It occurs but rarely in Maryland, and seems to affect the colder parts of the State, where the vegetation is from a week to ten days later in developing than in the lowlands of the warm areas.

2. *H. bijugis.*

Homœmus bijugis, Uhler, Hayden's Geol. Surv. of Montana, 393.

Collected by the survey of 1871 in Colorado, and during 1873 by Lieutenant Carpenter, from the foot-hills of Colorado, in September; vicinity of Denver City, by B. H. Smith; also received from Dakota and Nebraska.

3. *H. consors.* New sp.

Testaceo-fulvous; pale yellowish beneath; more acute at both ends than *H. æneifrons.* Head more triangular and narrower, more finely punctured, sparingly pubescent, less convex; the surface brassy-black, greenish at base; the lateral submargin with a narrow yellow line extending to the apical margin each side of tylus; the lateral margins distinctly sinuated; antennæ and rostrum testaceous, with the tips fuscous. Pronotum testaceous, tinged with brown, finely and obsoletely punctured; the lateral margins rather broadly compressed; each side of disk with a forked fuscous ray, the ends diverging posteriorly; exterior to this anteriorly is a short fuscous line, on the middle a fainter fuscous line, and a similar one along the submargin; the spot in the anterior angles very distinct. Scutellum very much narrowed obliquely posteriorly, very finely, rather obsoletely punctured; on the base is a trifarious black spot, the middle end of which runs to a point a little way back; the lateral ends indistinctly connected with a gradually narrowed ray, which runs obliquely backward; each side of base with pale streaks, exterior to which is an angular, fuscous spot; on the middle is an interrupted pale line; and on the tip an oblong pale spot, which narrows to a point anteriorly, and placed on a fuscous cloud. Venter pale, remotely, finely punctured; the punctures denser and finer on the sides; the sixth segment strongly carinated on the posterior margin; connexivum superiorly, with a black spot on each segment.

Aulacostethus, Uhler.

A. simulans. New sp.

Oval; moderately long; convex in both diameters; testaceous; clouded with ochreous; densely, minutely punctured with fuscous. Head ochreous, confluently, and more coarsely punctured; the lateral edge inferiorly and the tylus at tip smooth, yellow; lateral margins deeply sinuated;

below this the cheeks deeply excavated and coarsely punctured with fuscous; the lower cheeks yellow, smooth inferiorly; above this with remote, deeply-sunken, coarse, rufous punctures; antennæ yellow; the apex of basal joint on the upper side with a fuscous ring; the second and third joints with a fuscous longitudinal line both above and below; the basal joint stouter, subequal to the second; the third a little shorter; fourth and fifth lost from the specimens. Buccula punctured with fuscous; rostrum yellow; labrum with a black streak; the third and fourth joints tinged with piceous; the apex of the latter almost black. Pronotum dull testaceous, ochreous anteriorly, rather remotely, minutely punctured with fuscous; the anterior slope steeply convex; the lateral margins convexly arcuated; humeral angles bluntly rounded; the posterior angles still more so; the disk with about four series of transverse, interrupted black lines; the anterior margin indented each side. Pectus testaceous, remotely punctured with rufous, punctured anteriorly more minutely in patches with fuscous, and more coarsely posteriorly; the outer extremity of the duct fuscous, and with a large deep puncture there. Legs short, stout, yellow; the femora and tibiæ dotted with fuscous, the dots coalescing on the middle of the posterior and intermediate femora, so as to form a ring; tarsi at tip tinged with piceous. Scutellum rather suddenly convexed at base; lateral margins parallel, obliquely narrowed toward the tip; the tip truncated, with the angles rounded, ochreous; base of the convexity having a large, pale-yellow crescent with the points directed backward, and slenderly and faintly continued backward to behind the middle of the lateral margins; anterior to this continuation each side is a large fuscous cloud, which is invaded on the outside posteriorly by a pale angular spot, and at base exteriorly by a darker patch, which runs back to the angular spot; at base each side of the lunule are several short, transverse black lines, and more exteriorly some black points; posterior surface reticulated with black; at the apex a transverse, oval, yellow spot, with a black dot on the middle posteriorly; the anterior edge of the spot bounded with black, and with a slender black line running forward from it. Venter pale, dull testaceous, punctured remotely with red, and with denser fuscous punctures in a broad band each side, upon which is a series of five spots composed of denser black punctures; the stigmatal orifices placed on small tubercles; connexivum with spots of crowded fuscous punctures near the apex of the segments; the postero-lateral angles slightly produced; last ventral segment elevated and produced in a truncated plate over the base of the first genital segment. ♀.

Length, 9 millimeters. Width of pronotum, 5⅓ millimeters.

Inhabits the vicinity of San Francisco in May (Henry Edwards).

PACHYCORIS, Burm.

P. Fabricii.

Cimex Fabricii, Linn., Mantis. Ins. 534.
Pachycoris Fabricii, H. Schf., Wanz. Ins. iv, 6, fig. 349.
Pachycoris Stalii, Uhler, Proc. Entom. Soc. Phila. ii, 159.

Inhabits California, Mexico, &c. It will no doubt hereafter be collected in Arizona and New Mexico.

SPHYROCORIS, Mayr.

S. obliquus.

Pachycoris obliquus, Germar, Zeits. i, 94, No. 24.
Sphyrocoris obliquus, Mayr, Novara Reise, Hem. 26.

Inhabits Arizona; but has been previously known only from the West Indies and Mexico.

Zophoessa, Dallas.

1. *Z. consocia.* New sp.

Form of *Z. porosa*, Germar; brownish-black, with a brassy tinge; minutely sericeous pubescent. Head more broadly, less abruptly sinuated each side; antennæ piceous; the base and tip of the second, third, and fourth joints, and the basal joint entirely, testaceous; the basal and apical subequal, longer than the others; the third shortest; rostrum pale yellowish, invaded with piceous on the basal, third, and apical joints. Pronotum narrowly, transversely, but deeply and abruptly, incised; anterior to this is another incised line, which does not reach the lateral margins; the lateral margin less deeply sinuated than in *Z. porosa*. Corium testaceous at tip. Tarsi testaceous; the last joint and nails piceous. Scutellum widened posteriorly, crossed by several impressed lines between the base and the middle; the surface broken into reticulated ridges of more or less distinctness; on the base each side of the middle is an elongated spot; the middle line interruptedly, and several small, irregular spots at tip, yellow; the apical margin bluntly, a little obliquely, rounded. Yellow spots of the edge of connexivum small. ♀.

Length, 5 millimeters. Width of pronotum, scant 3 millimeters.

Inhabits Arizona (John Akhurst).

The surface is closely and deeply punctured, as in the other species.

2. *Z. porosa.*

Pachycoris porosus, Germar, Zeits. i, 108, No. 56.
Zophoessa porosa, Dallas, Brit. Mus. List Hemipt. i, 43.

Inhabits California, Texas, Florida, &c.

Subfamily EURYGASTRINA.

Eurygaster, Lap.

E. alternatus.

Tetyra alternata, Say, Amer. Ent. tab. iii, 43, fig. 3.
Eurygaster alternatus, Dallas, Brit. Mus. List Hemipt. i, 47, No. 1.

Inhabits the hills of Colorado in September. Collected by Lieut. W. L. Carpenter. It is quite common in many parts of the cold division of the north-temperate zone, extending quite across the continent from Maine to Puget Sound, and south to near San Francisco. On the eastern side of the continent, it has not yet been captured as far south as Maryland.

Subfamily PODOPINA.

Podops, Lap.

P. dubius.

Scutellera dubia, Pal., Beauv. Ins. Afr. et Amer. 33, pl. 5, fig. 6.
Tetyra cinctipes, Say, Amer. Ent. iii, tab. 43, fig. 2.

Inhabits Nebraska, Minnesota, Texas, and generally throughout the Atlantic region from Massachusetts to Florida.

Phimodera, Germ.

P. torpida.

Phimodera torpida, Walker, Brit. Mus. Catal. of Hemipt. pt. i, 75, No. 4.

Black; dull; elliptical; slightly convex; minutely punctured. Head subquadrate, less than half the breadth of the pronotum; the tylus

hardly extending beyond the lateral lobes. Eyes rather prominent. Pronotum with a transverse furrow, in front of which it is transversely rugulose; on the middle with a very short, whitish, longitudinal line. Scutellum covering the whole of the tergum, and almost the whole of the hemelytra, with three longitudinal lines, the middle one extending along the whole length, the other two very short, extending from the fore border; each with a short, oblique ridge near its outer side.

Length, 7 millimeters.

One specimen from Colorado, collected by B. H. Smith. The original type came from the region of the Saskatchewan in British America.

The description is added in this place to call the attention of western collectors to this interesting and peculiar species, with a view to obtaining a series of both sexes for the better elucidation of its affinities, and to establish its position in the group.

In Europe, this genus is represented by two species—one in France and Hungary, and the other in Sweden and Russia; but this is the first time that we have had evidence of the presence of one of its representatives on this western continent.

Superfamily PENTATOMOIDEA.

Scutellum much narrower than the abdomen, contracted behind the middle, usually triangular, having a frænum running from the base along the sides.

Family CYDNIDÆ.

Cyrtomenus, Am. & Serv.

C. mutabilis.

Cydnus mutabilis, Perty, Delectus Anim. Artic. 33, fig. 6.
Cyrtomenus castaneus, Am. & Serv., Hemipt. 91, No. 1.

Inhabits Arizona, Mexico, Texas, California, Brazil, Florida, Georgia.

Pangæus, Stål.

1. *P. bilineatus.*

Cydnus bilineatus, Say, Journ. Acad. Phila. iv, 315, No. 1.
Æthus bilineatus, Dallas, Brit. Mus. List Hemipt. i, 119, No. 20.

Inhabits Indian Territory, Kansas, Texas, and Eastern Temperate North America as far south as Central Florida.

2. *P. piceatus.*

Pangæus piceatus, Stål, Hemipt. Mex. Stettiner Entom. Zeit. xxiii, 96, No. 47.

Inhabits New Mexico, Texas, and Mexico.

Microporus, Uhler.

Aspect of *Cydnus;* hairy and opaque, polished, oval, moderately convex. Head broadly rounded, feebly convex; the tylus shorter than the lateral lobes; lateral submargins closely armed with linear, stout teeth, fringed with long, stiff hairs; the edge sharp, recurved, but broad beneath. Antennæ, basal joint barely reaching the tip of head; second very short, a little more than one-half the length of the third; third more slender, fusiform; shorter than the basal, but about of the same

length as the fourth; fourth and fifth stouter, rounded at each end, subequal. Rostrum reaching between the intermediate coxæ; second joint longest; third and fourth subequal, a little shorter than the basal one; bucculæ narrow, sublinear. Pronotum transverse, obsoletely transversely impressed; surface curving uniformly with the head; the anterior angles bluntly rounded; the lateral margins fringed with long ciliæ. Anterior femora compressed; armed with very stout spines on the outer and inner edges; those of the tip longest. Odoriferous canal placed inwardly, very short, spoon-shaped, scooped out. Scutellum about two-thirds as long as the abdomen, bluntly triangular, bluntly rounded at tip, the apex a little bent down. Corium short and wide, the outer angle produced backward; embolium long, grooved quite, or almost, throughout. Outer margins of the venter compressed.

1. *M. obliquus.*

Microporus obliquus, Uhler, Hayden's Survey of Montana, 394.

Inhabits the vicinity of Ogden, Utah; also in Arizona (Dr. George Horn).

2. *M. testudinatus.* New sp.

Ovate, broadly rounded, more convex than in *M. obliquus.* Head convexly declining, conforming to the curve of the pronotum; the anterior margin broadly recurved and rounded, feebly emarginated in front; the submargin with long setæ and close stout spines, of which two are on the tip of the tylus; surface smooth, polished, impunctured; near the eye is a sunken point, and running obliquely forward each side from the tylus is an impressed line; tylus shorter than the lateral lobes; the latter bluntly rounded and obsoletely wrinkled; antennæ pale ferruginous; the second joint slender, much the shortest, cylindrical; the third, fourth, and fifth subequal in length; rostrum reaching between the intermediate coxæ, pale ferruginous; the third and fourth joints subequal, together longer than the second. Pronotum transverse, in front much narrower than behind; the anterior margin deeply sunken to receive the head; the angles moderately protracted forward, bluntly rounded; the lateral margin steeply declining, the edge very thin, convexly arcuated, closely fringed with long ferruginous hairs; posterior margin feebly rounded; the exterior angles slightly rounded, rectangular; surface smooth, polished, obsoletely punctured each side and behind the middle; the anterior lobe smoother, and with a very few minute punctures; behind each eye is a sunken point, and across the middle a series of six similar points. Pectus pale piceous; the disks of pleural pieces darker; sides of prosternum a little raised into slender, slightly-rounded lobes. Legs pale ferruginous, more or less tinged with piceous; the spines blackish-piceous; femora compressed, having two rows of punctures carrying ciliæ; anterior tibæ compressed, the spines of outer margin longer; the exterior submargin with a slender groove bearing coarse punctures; the posterior tibiæ long, feebly curved, hardly thicker toward the end; tarsi slender, yellow, the intermediate joint small. Scutellum very broad, short, polished, convex, remotely, finely, rather obsoletely punctured; the sides not distinctly sinuated; the tip broad, bluntly rounded. Corium short, much wider behind; the costal margin very convexly arcuated, moderately uniformly, deeply punctured; the sutures punctured in rows; the subcostal linear impression continued from the base to beyond the middle, and coarsely punctured; posterior margin bluntly oblique, a little bluntly produced at the outer angle; mem-

brane short, broadly rounded, pale brownish. Venter very convex, polished, ciliated across the segments, and with long hairs on the outer edge of the connexivum; the lateral and posterior surface minutely punctured.

Length, 4½ millimeters. Width of pronotum, 2½ millimeters. Width of venter, 3 millimeters.

Inhabits California (James Behrens).

In one specimen, there is a transverse, impressed line placed a little before the posterior margin of the pronotum; in another, this line is hardly visible.

Trichocoris, Uhler.

Oval, moderately convex above, more or less hirsute, very convex beneath. Head bluntly semicircular, deeply seated in the pronotum; the anterior angles of the pronotum protracted as far as the middle of the eyes. Eyes sunk to the middle in the margin of the head; the ocelli placed not far from them, and on a line with their base. Submargin of the clypeus with erect, stout, short spines; the margin a little recurved; tylus broad, flat, not narrowed anteriorly, defined almost to the base of the cranium; the lateral lobes longer, but curving in front of it. Rostrum reaching beyond the anterior coxæ; the second joint longest, but not as long as the third and fourth united, compressed; the third and fourth subequal. Antennæ moderately stout; basal joint subcylindrical, slightly curved, as long as the fifth; second shortest; third somewhat longer, conical at base; the fourth and fifth equal, stouter, fusiform; the latter acute at tip. Pronotum transverse, trapezoidal; the lateral margins obliquely narrowing anteriorly, and gently curved. Odoriferous canal running outward almost half-way to the lateral margin, slenderly sulcated, situated rather remotely from the suture, becoming slightly tubular at the outer end; the plate on which it is placed narrow, acutely triangular beyond the osteole. Scutellum about two-thirds as long as the abdomen, broad and long, bluntly rounded at tip, the base convexly prominent, the sides not sinuated. Hemelytra broad, a little wider than the abdomen, shorter than the scutellum, the costal margin broadly arcuated; the posterior margin of the corium bluntly oblique, a little sinuated; membrane obliquely declining. Legs stout; femora compressed, ciliated, expanded before the tip; the anterior tibiæ a little less compressed than in *Cyrtomenus*, subtriquetral when seen from above; the long, stout spines arranged in a whorl at tip; posterior tibiæ much longer than the intermediate. Venter obesely convex; the segments fringed with long, remote ciliæ; the lateral margins densely set with long hairs.

T. conformis. New sp.

Moderately broad-oval, blackish-piceous, densely clothed exteriorly, and less densely superficially, with long ferruginous hair. Head flat, coarsely punctured in more or less oblique lines, or irregularly punctured and wrinkled, clothed each side with long, remote, erect hairs; spines of the submargin close-set, erect; the tip of the tylus armed with two spines; apex of the clypeus quadrately emarginate. Antennæ rust-brown; the basal joints somewhat piceous; the third, fourth, and fifth joints particularly clothed with fine yellow pubescence. Lateral margin and eyes reddish-brown. Rostrum reaching behind the anterior coxæ; the basal joint almost hid by the bucculæ; the second longest, almost as long as the third and fourth together; the third and fourth subequal. Pronotum blackish-piceous, sometimes tinged with rufous on the lateral

margins, almost twice as broad as long; the anterior angles broadly prominent, rounded; lateral margins oblique; posterior margin subtruncated; the surface variolosely punctate behind the middle, somewhat so on the anterior margin, and more densely on the sides; anterior part of the disk to behind the middle highly polished; the punctate surface and lateral margin invested with remote, long, rust-brown hairs, those of the sides longer. Scutellum almost as broad as long, remotely and more finely punctate, becoming finer posteriorly, with remote, long, rust-brown hairs. Sides of the prosternum anteriorly a little raised into flat lobes; medio- and post-pectus coarsely, remotely punctate. Corium broad, broader behind, finely, remotely, obsoletely, on the exterior area more densely and deeply, punctate, with remote long hairs; the lateral edge densely hirsute; membrane brownish. Legs rufo-piceous; the tarsi ferruginous and very slender, the intermediate joint very small; anterior femora on the upper side and exterior to the middle line with a series of broad, shallow pits; the femora and tibiæ ciliated with long ferruginous bristles. Venter obesely convex, polished, invested with long ferruginous hairs; the sides deeply, finely, and behind more closely, punctate; sides of the segments exteriorly with a line of coarse punctures; the middle broadly impunctate; connexivum roughly punctate; the edge posteriorly faintly waved. ♂. ♀.

Length, 5½ to 6½ millimeters. Breadth of pronotum, 3 to 3½ millimeters.

Inhabits California (Dr. G. Horn); San Francisco (James Behrens).

Amnestus, Dallas.

A. pusillus. New sp.

General form of *A. spinifrons*, Say; very pale ferruginous, polished. Pronotum a little narrower anteriorly; the lateral margin anteriorly abruptly rounded; transverse line deeply impressed; the surface coarsely punctured; the humeri and posterior margin more finely punctured; the lateral submargin more broadly depressed posteriorly. Scutellum small, triangular, pointed, rufo-piceous, closely punctured. Legs flavo-testaceous or pale ferruginous; the anterior femora unarmed, ciliated; the anterior tibiæ compressed, with the spines rather long and slender. Corium paler than the pronotum, coarsely, closely punctate; the disk more remotely so; posterior margin deeply sinuated; membrane transparent, faintly whitish, much shorter than the corium. Venter with prostrate pubescence, minutely rugulose, moderately convex.

Length, 2 to 2½ millimeters. Width of pronotum, 1 to 1¼ millimeters.

Inhabits Indian Territory, Texas, Cuba, and generally the Eastern United States south of Cape Cod. It lacks the femoral tooth, which is so conspicuous in *A. spinifrons*.

Macroporus, Uhler.

Broad-oval, feebly convex; the sides of the head and pronotum sparingly ciliated. Head broad, clypeate; the margins broadly reflexed, armed with short spines; tylus flattened, a little narrowed at tip, the recurved margin crossing its tip; bucculæ almost percurrent, not widened at tip; rostrum reaching between the intermediate coxæ; the basal joint a little shorter than the bucculæ, the second rather shorter than the third and fourth united; these latter subequal. Antennæ moniliform toward the apex; the basal and second joints slender, cylindrical; the second scarcely half as long as the third; the third, fourth, and fifth subequal, stouter; the fifth acute at tip. Pronotum transverse, quad-

rangular; the anterior margin deeply sinuated, bluntly carinated; the anterior angles rounded, and prolonged to before the middle of the eyes; the lateral margins a little oblique, anteriorly a little curved, remotely ciliated; the edge recurved; posterior margin a little convexly curved; the lateral angles moderately obliquely rounded; the margin interior to the humeri feebly sinuated; disk posteriorly obsoletely, transversely impressed, each end of the impression excavated, and behind each eye an excavated point. Corium broad, reaching to the penultimate segment of the abdomen; the costal margin broadly curving inward at tip. Scutellum short, almost as wide as long; the tip narrow, obliquely rounded, not extending beyond the inner angle of the corium; the sides feebly sinuated.

M. repetitus.

Castaneous or rufo-piceous: broader posteriorly. Head bluntly rounded in front, with short, close spines, and remotely hairy; the margins broadly recurved, rufescent; submargin grooved; disk a little convex, irregularly, rather finely punctured; the base almost impunctured; the posterior margin broadly excavated each side; adjoining each eye and in each basal corner of the tylus with a small, round pit; ocelli red, very remote, placed near and a little behind the line of the eyes; rostrum ferruginous or pale piceous, reaching between the intermediate coxæ; the second joint much compressed, and a little shorter than the third and fourth united; antennæ moderately stout; second joint scarcely half as long as the third; third gradually enlarged toward the tip; fourth and fifth joints subequal, subfusiform. Pronotum broader than long, narrowing anteriorly, transversely impressed, smooth, finely and closely punctured, excepting the anterior part of the disk; the anterior margin deeply excavated, with the whole edge recurved; anterior angles prominently prolonged, angularly rounded; lateral margins arcuated anteriorly; the edge recurved; the submargin depressed, ciliated with long, close hairs; lateral angles rectangular, smooth, with steep sides, and feebly rounded; the intra-humeral impressions shallow. Pectus rufo-piceous, darker on the posterior pleural pieces, smooth, impunctured; the lateral margins of the prosternum slightly elevated. Legs and coxæ pale flavo- or rufo-piceous; the anterior tibiæ moderately compressed, having about six spines on the outer edge; the spines of the posterior tibæ black-piceous; tarsi testaceous; the intermediate joint small. Scutellum a little flattened, polished and impunctured on the disk; the remaining surface closely punctured, minutely rugulose, before the tip a little sinuated; the edge very narrowly recurved; tip faintly impressed; obsoletely carinated. Corium broad, moderately convex, smooth, coarsely, closely punctured, on the disk obsoletely punctured; the costal margin broadly, convexly arcuated; the edge broad and distinctly recurved; the posterior margin faintly sinuated, furnished with a thinner border, and with the outer angle a little produced; embolium broad, reaching to the second ventral segment, minutely scabrous; the membrane brownish, moderately declivous posteriorly. Venter polished, minutely shagreened, and wrinkled each side and behind; the genital segment almost vertical, and crowned with a few erect hairs.

Length, 3½ to 4 millimeters. Width of pronotum, 2 to 2⅓ millimeters.

Inhabits San Francisco; received from Messrs. Henry Edwards and James Behrens.

A single specimen was also found by myself on the side of a hill two miles west of Baltimore, beneath a stone. Thus far, only females have been obtained.

MELANÆTHUS, Uhler.

Elongate-oval; the margins remotely ciliated all around. Head semicircular in front; the margins either feebly or obsoletely recurved; the submargin ciliated, but destitute of spines; tylus as long as the lateral lobes; occiput broad; the base of the head each side of it not scooped out; bucculæ almost percurrent, distinctly higher at the posterior end; rostrum reaching almost or quite to the intermediate coxæ; basal joint as long as the bucculæ; the second longest, a little longer than the third; third longer than the fourth, and only a little shorter than the second; the fourth subequal to the basal joint; antennæ moderately stout and long; the basal joint stouter than the second, but not so stout as the fifth, a little narrowed at tip; second slender, either longer or shorter than the third; third thicker toward the tip; fourth longer; fifth longest, and, together with the preceding joint, subfusiform. Pronotum distinctly transverse, very feebly convex; the lateral margins almost straight, a very little curved inward anteriorly; the edge recurved; anterior margin broadly sinuated; posterior margin subtruncated. Scutellum longer than broad, acutely narrowing toward the tip; the tip narrow, acutely rounded, overlapping the inner apex of the corium. Exterior field of the corium broad, depressed; the costal margin curved inward toward the tip, leaving the connexivum exposed posteriorly; the posterior margin moderately oblique, feebly arcuated; the exterior tip a little produced. Legs normal; the anterior tibiæ very moderately compressed. Venter moderately convex; the connexivum impressed longitudinally; the edge sharp and prominent. Odoriferous tube very slender, running outward about two-thirds of the distance to the exterior edge, and terminating in a flat button.

M. elongatus. New sp.

Deep black, shining, elongate-oval; the sides very parallel. Head semicircular, a little convex on the cranium, densely punctured, remotely punctured at base; the submargin broadly depressed, remotely ciliated; the margin recurved; tylus very short, a little cylindrically elevated, reaching as far as the lateral lobes, minutely rugulose, each side of it and the surface near each eye having a small sunken point; antennæ stout, dark piceous; the joints paler at each end; the second most slender, shorter than the third; the third enlarging toward the tip, a little shorter than the fourth; fifth longest; rostrum reaching not quite to the intermediate coxæ, rufo-piceous; the second joint longest; the third a little shorter; fourth shortest. Pronotum subtrapezoidal, fully twice as broad as long; the lateral margins anteriorly very slightly oblique, more suddenly rounded at the anterior angles; the edge recurved, remotely ciliated; front part of disk a little convexly elevated, polished, minutely rugulose; the remaining surface coarsely punctured; a transverse, impressed line crossing just before the base connects each side with a coarsely punctured line running forward from near the humeri, and with two impressed points near the junction of these lines; posterior margin truncated; the edge narrowly but abruptly decurved; the lateral angles rectangular. Antepectus polished, having a few small punctures; the prosternum a little carinated; meso-sternum distinctly carinated. Legs dark piceous; the posterior tibiæ long and slender. Scutellum extending not quite two-thirds the length of the venter, acutely narrowing toward the tip, with a transverse hump at base, and a narrower lunate impression behind it; the surface polished, minutely punctured; the lateral impressed lines broad, shallow, roughly punc-

tured; the tip narrow, acutely rounded, projecting a very little way over the membrane. Corium a little wider posteriorly; costal margin a little abruptly curved inward at tip; posterior margin moderately oblique, a little convexly arcuated near the inner angle; the outer angle a little prolonged, very blunt; membrane pale-brownish, hardly half as long as the corium, with three or four very indistinct nervures. Venter slightly convex, polished; the sides, connexivum, and genital segment minutely roughened and punctured; the connexivum broadly depressed; the edge prominent and trenchant.

Length, 3½ millimeters. Width of pronotum, 1¾ millimeters.

Inhabits California.

A single mutilated female was received from Henry Edwards.

Sehirus, Amyot & Serv.

S. cinctus.

Pentatoma cincta, Palisot-Beauv. Ins. Afr. et Amer. 114, pl. 8, fig. 7.
Cydnus lygatus, Say, Heteropt. New Harmony, 10, No. 1.
Sehirus albonotatus, Dallas, Brit. Mus. List Hemipt. i, 127, 2.
Sehirus cinctus, Stål, Hemipt. Afr. Note, i, 29.

Inhabits New Mexico, Texas, in Tamaulapas, Mexico, and the United States pretty generally. It has not yet, however, been brought from the territories north of New Mexico, although it is found in Canada, not far from Quebec. The males usually have a smaller emargination of the front of the clypeus than the females; and they are also more frequently destitute of the white spot of the corium.

Subfamily ASOPINA.

Stiretrus, Lap.

S. anchorago.

Cimex anchorago, Fab., Syst. Rhyng. 137, 44; Ent. Syst. 86.
Tetyra diana, Fab., Syst. Rhyng. 137, 45.
Pentatoma pulchella, Westw., Hope Catal. i, 42.
Asopus variegatus, H.-Schf., Wanz. Ins. iv, 90, fig. 427.
Stiretrus fimbriatus, Dallas, Brit. Mus. List Hemipt. i, 81, 10.
Tetyra violacea, Say, Amer. Ent. pl. 43, fig. 2.

Inhabits Texas, New Mexico, and the Southern States. The variety *S. fimbriatus*, Dallas, extends as far north as Massachusetts, while it is not uncommon in all the States north of Virginia. Almost all the varieties, from an almost uniform yellow *fimbriatus* through the red and blue *diana* to the uniform violet *violacea*, have passed through my hands. The latter variety has been taken once near Philadelphia; in Georgia; in Florida; and once, also, in Texas by Mr. Boll.

Perillus, Stål.

1. *P. claudus.*

Pentatoma clauda, Say, Journ. Acad. Phila. iv, 312, No. 2.

Inhabits Colorado, Dakota, Northern California, New Mexico, Utah, and Arizona (C. V. Riley).

2. *P. exaptus.*

Pentatoma exapta, Say, Journ. Acad. Phila. iv, 313, No. 3.
Zicrona marginella, Dallas, Brit. Mus. List, i, 109, 5.
Pentatoma variegata, Kirby, Fauna Bor.-Am. 276, No 384.

Inhabits Colorado, Dakota, Canada, New England, &c.

3. *P. circumcinctus.*

Perillus circumcinctus, Stål, Hemipt. Mex. Stettiner Ent. Zeit. 23, 89.

Inhabits Nebraska, Missouri, Canada, Dakota, New England, Panama, and the island of Trinidad.

4. *P. confluens.*

Asopus confluens, H.-Schf., Wanz. Ins. v, 77, fig. 522.
Perillus confluens, Stål, Enumeratio Hemipt. i, 32.

Inhabits Texas, New Mexico, and Mexico to Guatemala.

Thus far, only one type of variety of this species has been found in the Southwestern United States; but in Mexico it offers many varieties, some of which possess great brilliancy and richness of colors.

5. *P. splendidus.*

Zicrona splendida, Uhler, Proc. Ent. Soc. Phila. 1863, i, 22.

Inhabits California (James Behrens); San Diego (H. Edwards); Fort Crook (Dr. George Horn); Texas (G. W. Belfrage).

MINEUS, Stål.

M. strigipes.

Podisus strigipes, H.-Schf., Wanz. Ins. ix, 338.
Mineus strigipes, Stål, Enumeratio Hemipt. i, 32.

Inhabits Texas, New Mexico, New York, South Carolina, Georgia, and Maryland.

RHACOGNATHUS, Fieber.

R. americanus.

Rhacognathus americanus, Stål, Enumeratio Hemipt. i, 33, No. 2.

Inhabits Illinois, Nebraska, and Canada.

ZICRONA, Amyot & Serv.

Z. cuprea.

Zicrona cuprea, Dallas, Brit. Mus. List Hemipt. i, 108, No. 2.

Inhabits Arizona; Snake River region, Idaho; Fort Defiance, New Mexico; and British America.

PODISUS, Stål.

1. *P. cynicus.*

Pentatoma cynica, Say, Heteropt. New Harmony, 3, No. 1.
Arma grandis, Dallas, Brit. Mus. List Hemipt. i, 96, 3.

Inhabits Dakota, Nebraska, Arizona, Missouri, Illinois, Massachusetts, New York, &c.

2. *P. spinosus.*

Arma spinosa, Dallas, Brit. Mus. List Hemipt. i, 98, No. 7.

Inhabits Nebraska, Kansas, California, Texas, and the Atlantic region generally.

3. *P. pallens.*

Arma pallens, Stål, Eugenies Resa, Hemipt. 222, No. 6.

Inhabits California; San Francisco (James Behrens).

The small differences in the lateral angles of the pronotum and in puncturing do not seem to me sufficient to separate this from *P. modestus.*

4. *P. modestus.*

Arma modesta, Dallas, Brit. Mus. List Hemipt. i, 101, No. 13.
Podisus modestus, Stål, Enumeratio Hemipt. i, 51, No. 13.

Inhabits Dakota, Nebraska, Illinois, Canada, and the Eastern United States as far south as Georgia.

Tylospilus, Stål.

T. acutissimus.

Tylospilus acutissimus, Stål, Enumeratio Hemipt. i, 53, No. 27.

Inhabits Texas, Colorado, and Mexico.

Subfamily HALYDINA.

Brochymena, Amyot & Serv.

1. *B. myops.*

Brochymena myops, Stål, Enumeratio Hemipt. ii, 16, No. 1.
Halys quadripustulata, H.-Schf., Wanz. Ins. vii, 57, fig. 729.

Inhabits Texas, New Mexico, Louisiana, and Mexico.

2. *B. annulata.*

Cimex annulatus, Fab., Syst. Ent. 704, No. 38.
Halys annulata, H.-Schf., Wanz. Ins. vii, 57, fig. 728.
Halys serrata, Wolff, Icones Cim. 184, fig. 178.

Inhabits Colorado, Texas, and a large part of the United States east of the Mississippi River.

3. *B. obscura.*

Halys obscura, H.-Schf., Wanz. Ins. v, 68, fig. 513.
Brochymena obscura, Stål, Enumeratio Hemipt. ii, 16, No. 4.

Inhabits Arizona, California, Mexico, &c.

4. *B. arborea.*

Pentatoma arborea, Say, Journ. Acad. Phila. iv, 311, No. 1; Complete Writings, ii, 239.
Halys erosa, H. Schf., Wanz. Ins. v, 70, fig. 515.
Brochymena arborea, Dallas, Brit. Mus. List Hemipt. i, 188, No. 1.

Inhabits Texas, New Mexico, Indian Territory, Mexico, Kansas, and most of the eastern regions of the United States from Maine to Florida.

Prionosoma, Uhler.

P. podopioides.

Prionosoma podopioides, Uhler, Proc. Ent. Soc. Phila. 1863, ii, 364.
Prionosoma podopioides, Stål, Enumeratio Hemipt. ii, 32.

Inhabits California, Arizona, Colorado, and Nevada.

Specimens have been sent to me from Denver City by Mr. B. H. Smith.

Subfamily PENTATOMINA.

Mecidea, Dallas.

M. longula.

Mecidea longula, Stål, Öfv. Vet. Acad. Forhandl. 1854, 233, No. 2; *ib.* 1856, 57, No. 2.

Inhabits Texas; New Mexico (Dr. J. L. LeConte).

ÆLIA, Fab.

Æ. americana.

Ælia americana, Dallas, Brit. Mus. List, i, 223, No. 1.

Inhabits Nebraska, Dakota, and British America.

This interesting insect is almost unknown to our American entomologists; only two (damaged) specimens have thus far came to my notice.

We beg particularly to call the attention of western collectors to this interesting genus, which should yield other and perhaps new species in return for moderately close collecting in shrubby spots where the small growths are rank and dense.

In Europe, the genus is represented by more than a half-dozen species.

NEOTTIGLOSSA, Kirby.

N. undata.

Pentatoma undata, Say, Heteropt. New Harmony, 8, No. 17; Complete Writings, i, 319, 17.
Neottiglossa trilineata, Kirby, Fauna Bor.-Amer. iv, 276, pl. 6, fig. 6.

Inhabits Colorado, Nebraska, Canada, and the Northern United States.

MELANOSTOMA, Stål.

M. sulcifrons.

Melanostoma sulcifrons, Stål, Enumeratio Hemipt. ii, 18.

Inhabits Texas and New Mexico.

A single specimen of this interesting little insect was captured by me near Egg Harbor City, N. J.

COSMOPEPLA, Stål.

1. *C. carnifex.*

Cimex carnifex, Fab., Ent. Syst. Suppl. 535, No. 162.
Eysarcoris carnifex, Hahn, Wanz. Ins. ii, 117, fig. 198; Dallas, Brit. Mus. List Hemipt. i, 225, No 3.
Pentatoma carnifex, Kirby, Fauna Bor.-Amer. iv, 275, No. 1.
Cosmopepla carnifex, Stål, Enumeratio Hemipt. ii, 19, No. 1; Hemipt. Fab. i, 23.

Inhabits Texas; Indian Territory; Nebraska; eastern part of Washington Territory; Port Neuf, Canada (Abbé Provancher); Nova Scotia; Illinois; and Maine to Georgia.

2. *C. conspicillaris.*

Eysarcoris conspicillaris, Dallas, Brit. Mus. List Hemipt. i, 225, No. 2.
Cosmopepla conspicillaris, Stål, Enumeratio Hemipt. ii, 19, No. 4.

Inhabits California, Vancouver's Island, and Mexico. On the hills and plains of Colorado, September 19 and October 4; collected by Lieut. W. L. Carpenter.

3. *C. decorata.*

Eysarcoris decorata, Hahn, Wanz. Ins. ii, 117, fig. 198.
Pentatoma decorata, H.-Schf., Wanz. Ins. vii, 96.
Cosmopepla decorata, Stål, Enumeratio Hemipt. i, 19, No. 2.

Inhabits Texas, Arizona, Mexico, and Guatemala.

It will be of peculiar interest to have full series of the three forms enumerated above, as it is highly probable that they constitute in reality but a single species. The first seems to be the continental form, but

which does not cross the meridian of the Sierra Nevada Mountains; the second does not cross beyond the eastern base of the Rocky Mountains; while the third is the subtropical southern form.

MORMIDEA, Amyot & Serv.

1. *M. lugens.*

Cimex lugens, Fab., Syst. Ent. 716, No. 98.
Cimex albipes, Fab., Ent. Syst. Suppl. 535, 162.
Cydnus lugens, Fab., Syst. Rhyng. 187, No. 12; Wolff, Icones Cim. 183, fig. 180.
Cimex gamma, Fab., Syst. Rhyng. Index, 7.
Pentatoma punctipes, Palisot-Beauv. Ins. Afr. et Amer. 113, pl. 8, fig. 6.
Pentatoma punctipes, Say, Journ. Acad. Phila. iv, 313, No. 4.
Pentatoma lugens, H.-Schf., Wanz. Ins. vii, 96.
Mormidea lugens, Stål, Stettiner Ent. Zeit. xxiii, 103, No. 73.

Inhabits Texas, Indian Territory, Cheyenne, Dakota, Nebraska, Mexico, and almost the whole of North America east of the Missouri and Mississippi Rivers.

Specimens were captured on Mitchell's Peak, and on some of the other high mountains of North Carolina, in August, at an elevation of more than 6,000 feet above sea-level, by my lamented late friend Dr. James B. Bean.

2. *M. sordidula.*

Mormidea sordidula, Stål, Enumeratio Hemipt. ii, 21, No. 18.

Inhabits Texas and New Mexico.

ŒBALUS, Stål.

Œ. pugnax.

Cimex pugnax, Fab., Syst. Ent. 704, No. 41.
Cimex typhœus, Fab., Syst. Rhyng. 162, No. 34.
Pentatoma orthacantha, Palisot-Beauv. Ins. Afr. et Amer. 130, pl. 9, fig. 9
Cimex typhœus, Wolff, Icones Cim. 180, fig. 174.
Pentatoma augur, Say, Heteropt. New Harmony, 3, No. 2.
Œbalus typhœus, Stål, Hemipt. Fab. i, 27.
Œbalus pugnax, Stål, Enumeratio Hemipt. ii, 22, No. 1.

Inhabits Texas, Arizona, Matamoras, Mexico, the Eastern United States generally, Cuba, and New Granada. It occurs at considerable altitudes on the Black Mountains of North Carolina, and is not unfrequent upon grassy and shrubby spots in Georgia and Florida. Miss Modeste Hunter collected it near Orange Springs, Florida, in the month of July.

In Maryland, it may be found on low spots in the meadows where the plants and grass grow rich and dense, in June, August, September, and October. It appears to lay eggs in late spring and toward the latter part of summer.

The Cuban form is usually larger, and has the lateral angles longer and more slender than in those from the United States.

EUSCHISTUS, Dallas.

1. *E. variolarius.*

Pentatoma variolaria, Palisot-Beauv. Ins. Afr. et Amer. 149, pl. 10, fig. 6.
Pentatoma punctipes, Say, Journ. Acad. Phila. iv, 314, No. 5; Complete Writings, ii, 241, No. 5.
Cimex ictericus, H.-Schf., Wanz. Ins. vi, 71, fig 639.
Cimex sordidus, H.-Schf., Wanz. Ins. vi, 70, fig. 637.
Euschistus punctipes, Dallas, Brit. Mus. List Hemipt. i, 207, No. 16.

Inhabits Colorado, Texas, and generally throughout the eastern side of the United States.

2. *E. ictericus.*

Cimex ictericus, Linn., Cent. Ins. 16, No. 41.
Pentatoma rubro-fusca, Palisot, Beauv. Ins. Afr. et Amer. 185, pl. 11, fig. 3.
Euschistus cognatus, Dallas, Brit. Mus. List Hemipt. i, 204, No. 10.
Euschistus ictericus, Stål, Enumeratio Hemipt. ii, 26, No. 23.

Inhabits Texas, Nebraska, Illinois, and the Atlantic States.

3. *E. fissilis.*

Euschistus fissilis, Uhler, Hayden's Survey of Montana, 396, No. 1.
Dicerœus euschistoides, Voll., Versl. Akad. Amst. ser. 2, ii, 180, No. 24.
Euschistus fissilis, Stål, Enumeratio Hemipt. ii, 26, No. 18.

Inhabits Colorado, Nebraska, Illinois, and parts of the Atlantic region.

4. *E. tristigmus.*

Pentatoma tristigma, Say, Heteropt. New Harmony, 4, No. 4; Complete Writings, i, 314.
Pentatoma tristigma, H.-Schf., Wanz. Ins. vii, 101, fig. 767.
Cimex pyrrhocerus, H.-Schf., *l. c.* vi, 71, fig. 638.
Euschistus luridus, Dallas, Brit. Mus. List Hemipt. i, 207, pl. 7, fig. 6.
Euschistus tristigma, Dallas, *l. c.* i, 207, No. 18.

Inhabits Texas, Indian Territory, Kansas, Missouri, and from Florida to New York. Those with blunt lateral angles have been obtained in Washington Territory, Kansas, Canada, New England, Pennsylvania, Maryland, Iowa, and New York. It sometimes occurs in large numbers, in late summer, on bushes in damp situations. No species thus far discovered in this country exhibits such a wide range of differences in the form of the pronotum. The form most common in Maryland has acute and acuminate lateral angles, but longer than in others from Pennsylvania, Virginia, Louisiana, and some other parts of the South. The large specimens, with bluntly-rounded angles, have not yet been collected by me in company with the other form. A whitish bloom often covers the mature specimens in this region.

5. *E. crenator.*

Cimex crenator, Fab., Ent. Syst. iv, 101, No. 87.
Pentatoma obscura, Palisot-Beauv. Ins. Afr. et Amer. 149, pl. 10, figs. 7 and 9.
Pentatoma pustulata, Palisot-Beauv. *l. c.* pl. 11, fig. 2.
Euschistus obscurus, Dallas, Brit. Mus. List, i, 208, No. 19.
Mormidea pustulata, Guer., in La Sagra's Hist. Nat. Cuba, Ins. 368.
Mormidea obscura, Guer., *l. c.* 366.
Euschistus crenator, Stål, Hemipt. Fab. i, 26.

Inhabits Texas, Mexico, Cuba, Florida, and Arizona.

6. *E. servus.*

Pentatoma serva, Say, Heteropt. New Harmony, 4, No. 5.
Euschistus servus, Stål, Enumeratio Hemipt. ii, 26, No. 19.

Inhabits Texas, New Mexico, California, Dakota, Illinois, Maryland, and the Southern States generally. In Texas and Florida, it attains to a very large size, with a greater aggregation of the black punctures on the head.

PROXYS, Spin.

P. punctulatus.

Halys? punctulata, Palisot-Beauv. Ins. Afr. et Amer. Hem. 188, pl. 11, fig. 9.
Cimex victor, Wolff, Icones Cim. 181, fig. 175.
Pentatoma tenebrosa, Say, Ins. of Louisiana, 8, and Heteropt. New Harmony, 10, No. 25; Complete Writings, i, 304, No. 2.

Prooxys victor, Amyot et Serv., Hemipt. 140.
Prooxys delirator, Amyot et Serv., *ib.* 140, pl. 3, fig. 7.
Prooxys punctulata, Guer., La Sagra's Hist. de Cuba, Ins. 370.
Prooxys brevispinus, Guer., *ib.* 371.
Proxys geniculata, Stål, Stettiner Ent. Zeit. xxiii, 102, No. 67.

Inhabits Cuba, San Domingo, Mexico, Texas, Indian Territory, Louisiana, Georgia, and Florida. One specimen has been captured near Philadelphia. Further collecting in Arizona and New Mexico will most likely yield specimens of this conspicuous species.

HYMENARCYS, Amyot & Serv.

1. *H. nervosa.*

Pentatoma nervosa, Say, Heteropt. New Harmony, 9, No. 20.
Pentatoma Pennsylvanicæ, Westw., in Hope Catal. i, 35.
Hymenarcys perpunctata, Amyot et Serv., Hemipt. 124, No. 1.

Inhabits Mexico, Texas, Indian Territory, Dakota, Missouri, Illinois, and from Massachusetts to Florida. In Maryland, it occurs with moderate frequency upon rank low herbage in meadows and about the skirts of woods. Like *Euschistus variolarius* and other species, it becomes, when senile, suffused with red, is dusted with a whitish powder, and seems then to have a more decidedly penetrative odor in the fluid which it sprays from the aperture of its glands.

2. *H. æqualis.*

Pentatoma æqualis, Say, Heteropt. New Harmony, 7, No. 15.
Cimex dentatus, H.-Schf., Wanz. Ins. v, 64, fig. 507.
Pentatoma boxura, Dallas, Brit. Mus. List Hemipt. i, 244, No. 29.

Inhabits Texas, Indian Territory, Mexico, and the Southeastern United States. In Maryland, it hibernates beneath stones in sheltered valleys, but is much less common than the preceding species.

CŒNUS, Dallas.

C. delius.

Pentatoma delia, Say, Heteropt. New Harmony, 8, No. 18.
Cœnus tarsalis, Dallas, Brit. Mus. List Hemipt. i, 230, pl. 8, fig. 6.
Cœnus punctatissimus, Voll., Versl. Akad. Amst. ser. 2, ii, 183.

Inhabits Texas, Indian Territory, Illinois, Massachusetts, New York, &c.

MENECLES, Stål.

M. insertus.

Pentatoma inserta, Say, Heteropt. New Harmony, 6, No. 11.
Menecles insertus, Stål, Öfv. Vetensk. Akad. Förh. 1867, 527.

Inhabits Kansas, Nebraska, California, Illinois, Missouri, Massachusetts, and Pennsylvania.

It varies somewhat in the length of the anterior angles of the pronotum, and in the depth of the sinus, which receives the head.

RHYTIDOLOMIA, Stål.

R. Belfragii.

Rhytidolomia Belfragei, Stål, Enumeratio Hemipt. ii, 33, No. 3.

Inhabits Illinois, Canada, and Nebraska.

CHLOROCHROA, Stål.

1. *C. Sayi.*

Chlorochroa Sayi, Stål, Enumeratio Hemipt. ii, 33, No. 6 (1872).
Pentatoma granulosa, Uhler, Hayden's Survey of Montana, 398 (1872).

Inhabits California, Arizona, Nevada, &c. The present specimens

were collected by Lieutenant Carpenter on the foot-hills of Colorado in September.

This is quite variable in size, depth of colors, and in the number and size of the bald white spots which occur on the scutellum and hemelytra. I am unable to decide which of the two names should have preference; both were published in the same year; but, perhaps, the one was issued a few days or weeks earlier than the other.

2. *C. congrua.* New sp.

Broadly oval, bright grass-green; the upper surface and margins of the pleuræ finely and deeply punctate between slender transverse rugæ. Head having the surface impressed each side of the tylus; the lateral lobes a little longer than the tylus; exterior margins acute, elevated, more deeply sinuate than in *C. Sayi.* Antennæ green, but with the apical, the fourth, and the third, almost to its base blackish, and these joints particularly granulose and setose; the second joint twice as long as the third, the third much the shortest. Rostrum reaching to the posterior coxæ, green; the middle line and apical joint black; basal joint a little shorter than the head; the second longer, reaching to the middle coxæ; the third and fourth subequal, but much shorter. Pronotum very short and broad; the lateral margins very distinctly and evenly reflexed, and continued around the broadly-rounded humeral angles, the margin inferiorly appearing broadly tabulate and smooth. Pleuræ coarsely punctate, but more finely so on the elevated areas; the anterior submargin transversely linearly carinated from the anterior angle to the sternal boundary. Prosternum broadly, deeply scooped out, triangular behind; mesosternum slenderly carinate; the metasternum produced backward triangularly, and a little scooped out before the tip. Legs green, the tarsi slightly rufous. Scutellum slenderly margined and more broadly tipped with white. Corium more minutely rugulose, finely punctate, the punctures grading finer posteriorly; embolium smooth, having a few remote and obsolete punctures, and, together with the adjoining margin, white. Membrane soiled white, having eleven longitudinal nervures. Wings white, with the coarse costal nervure piceous. Tergum black as far as to the penultimate segment, very minutely and closely punctured and rugulose. Venter smooth, remotely, obsoletely punctured, but almost destitute of punctures along the middle.

In one specimen, the lateral margin of the pronotum is white, more broadly so beneath, and the edge of the venter is deep orange. The inferior genital segment is hairy and scooped out in the form of a crescent.

Length, 9 to 12 millimeters. Width of pronotum, 5½ to 6½ millimeters.

Inhabits Colorado. Collected by Lieutenant Carpenter on the foot-hills of Colorado in September.

3. *C. ligata.*

Pentatoma ligata, Say, Heteropt. New Harmony, 5, No. 6.
Cimex rufocinctus, H.-Schf., Wanz. Ins. iv, 94, fig. 436.
Pentatoma marginalis, Walk., Brit. Mus. Catal. of Hemipt. ii, 288.

Inhabits California, Mexico, Texas, New Mexico, Arizona, &c.

Varies greatly in size; the red color of the margin of the pronotum and abdomen and the tip of the venter is sometimes substituted by pale green or whitish.

I do not think this subgenus can stand. The species composing it are congeneric with *Pentatoma juniperi*, Linn., and must be associated with it. If that species is really the type of *Pentatoma*, Oliv., then all these species must be placed therein.

4. *C. Uhleri.*

Chlorochroa Uhleri, Stål, Enumeratio Hemipt. ii, 33, No. 5.

Inhabits Colorado and Mexico.

It varies very much in size, and is of a remarkably vivid-green color.

CARPOCORIS, Kol.

C. lynx.

Cimex lynx, Fab., Ent. Syst. 110, No. 118.
Carpocoris lynx, Muls., Pun. France, ii, 254, No. 5.

Inhabits California, Montana, and Arizona.

Very variable in size, pattern of markings, and somewhat in shape, particularly of the pronotum.

TRICHOPEPLA, Stål.

T. semivittata.

Pentatoma semivittata, Say, Heteropt. New Harmony, 9, No. 21.
Pentatoma semivittatum, H.-Schf., Wanz. Ins. vii, 93, fig. 766.
Pentatoma pilipes, Dallas, Brit. Mus. List Hemipt. i, 247, No. 37.
Trichopepla semivittata, Stål, Enumeratio Hemipt. ii, 34.

Inhabits Texas, Nebraska, and the whole Atlantic region.

PERIBALUS, Muls.

P. modestus.

Peribalus modestus, Uhler, in Hayden's Survey of Montana, 396.

Inhabits Arizona, Texas, Kansas, Colorado, and the Atlantic region of the United States.

HOLCOSTETHUS, Fieb.

H. abbreviatus.

Holcostethus abbreviatus, Uhler, *l. c.* 397.

Inhabits Kansas, Texas, California, Colorado, and British America.

THYANTA, Stål.

1. *T. perditor.*

Cimex perditor, Fab., Ent. Syst. iv, 102, No. 90.
Pentatoma fascifera, Palisot-Beauv. Ins. Afr. et Amer. Hem. 150, pl. 10, fig. 8.
Pentatoma collaris, Westw., Hope Catal. i, 40.
Cimex dimidiatus, H.-Schf., Wanz. Ins. vi, 65, fig. 629.
Euschistus perditor, Dallas, Brit. Mus. List Hemipt. i, 206.
Pentatoma (*Mormidea*) *perditor*, Guer., in La Sagra's Hist. de Cuba, Ins. 367.
Euschistus fasciatus, Walk., Brit. Mus. Catal. Heteropt. ii, 245, No. 12.
Thyanta perditor, Stål, Hemipt. Fab. i, 29.
Euschistus adjunctor, Walk., *l. c.* ii, 249, No. 39.

Inhabits Texas, Mexico, West Indies, Arizona, Colorado, and Nebraska.

Its southern limit is Venezuela; and, as far as at present known, its most northern is Nebraska. As might be expected in a species extending throughout such widely different climates, it offers much variation in form and size. The southern forms are largest, have the most prolonged lateral angles to the pronotum, and are more distinctly and broadly marked with crimson on the pronotum.

2. *T. custator.*

Cimex custator, Fab., Syst. Rhyng. 164, No. 43.
Pentatoma calceata, Say, Heteropt. New Harmony, 8, No. 19; Complete Writings, i, 320, No. 19.
Pentatoma custator, H.-Schf., Wanz. Ins. vii, 96, fig. 771; Dallas, Brit. Mus. List Hemipt. i, 251.

Inhabits Lower and Upper California, Texas, Arizona, Colorado, Dakota, and the Atlantic region generally from Quebec to Florida.

The southern specimens are usually larger and more clearly marked with the yellow and red. Those from Lower California seem to lack the pronotal red band.

3. *T. rugulosa.*

Pentatoma rugulosa, Say, Heteropt. New Harmony, 7, No. 16.

Inhabits Texas (Mr. Belfrage); Cape Saint Lucas, Cal. (John Xanthus); Colorado (B. H. Smith); Cuba (Professor Poey). The specimens from Lower California are a little less robust, and have the lateral angles of the pronotum a little more acute than in those from Colorado. One specimen from Dakota, too much damaged to show its particular features.

LOXA, Amyot & Serv.

L. flavicollis.

Cimex flavicollis, Drury, Illustr. ii, 67, pl. 36, fig. 4.
Cimex albicollis, Fab., Spec. Ins. ii, 347, No. 51.
Pentatoma viridis, Palisot-Beauv. Ins. Afr. et Amer. Hem. 111, pl. 8, fig. 1.
Loxa flavicollis, Amyot et Serv., Hemipt. 137, No. 1.
Loxa virescens, Amyot et Serv., *l. c.* 137, No. 2.
Pentatoma albicolla, H.-Schf., Wanz. Ins. vii, 94; Stoll, Punaises, figs. 196, 198, 200.

Inhabits South America, the West Indies, and Mexico; but specimens have been collected in Texas and New Mexico, which I have had the privilege of examining. They differed in no considerable degree from others brought from Rio and Surinam. They exhibit a certain amount of variation in the length and acuteness of the pronotal serrations and lateral angles, which, in the specimens from Rio, are often much prolonged and very acute.

MURGANTIA, Stål.

M. histrionica.

Strachia histrionica, Hahn, Wanz. Ins. ii, 116, fig. 196.
Murgantia histrionica, Stål, Enumeratio Hemipt. ii, 37, No. 4.

Inhabits Guatemala, Mexico, Texas, Arizona, Indian Territory, California, Nevada, Colorado, and from Delaware to Florida and Louisiana.

Various patterns of marking, and colors ranging from yellow to steel-blue, are conspicuously exhibited in this pretty but unstable and pernicious insect.

In the Atlantic region, this species seems to be steadily but slowly advancing northward. Its introduction into Maryland has been effected since the late war, and now it is known as far north as the vicinity of the Pennsylvania boundary-line in Delaware.

In the Mississippi Valley, it appears to be equally common, particularly in the States of Illinois and Missouri.

ARVELIUS, Spin.

A. albo-punctatus.

Cimex albopunctatus, De Geer., Mem. iii, 331, pl. 34, fig. 6.
Cimex gladiator, Fab., Syst. Ent. 705, No. 43.
Pentatoma gladiator, Palisot-Beauv. Ins. Hem. 127, pl. 9, fig. 1.
Cimex leucostictus, Gmelin, Syst. Nat. 2148, No. 282.
Acanthosoma gladiator, Burm., Handb. ii, 359.
Acanthosoma luteicornis, Westw., in Hope Catal. i, 30.
Arvelius gladiator, Spinola, Essai Hemipt. 346; H.-Schf., Wanz. Ins. v, 104, fig. 557.
Arvelius albo-punctatus, Amyot et Serv., Hist. Hem. 150.
Pentatoma (*Arvelius*) *albopunctata*, Guer., La Sagra's Hist. de Cuba, Ins. 374; Stoll, Punaises, fig. 12.

Inhabits South America, West Indies, Mexico, Texas, Cape Saint Lucas, California, Arizona, and Florida.

A specimen measuring in length only 11½ millimeters was sent from Cuba by Professor Poey. It is destitute of the black rings of the antennæ. As in some other species of which we have examined long series, the punctures and rugæ are coarser or finer according to the size of the specimen. The white band on the front of the pronotum is absent from some specimens.

BANASA, Stål.

1. *B. euchlora.*

Banasa euchlora, Stål, Enumeratio Hemipt. ii, 44, No. 8.

Inhabits Texas, Indian Territory, Florida, Maryland, &c. Mr. G. W. Belfrage met with this species beneath the bark of cedar-trees near Waco, Tex.

2. *B. calva.*

Pentatoma calva, Say, Heteropt. 7, No. 13.
Rhaphigaster catinus, Dallas, Brit. Mus. List Hemipt. i, 282, No. 25.

Inhabits Canada, New England, New York, Maryland, Texas, Washington Territory, and Fort Grant, Ariz. (Dr. G. H. Horn).

This is the most beautiful of our species of *Raphigastrines;* the highly-polished surface of clear green with the purple band across the pronotum give it a very lively and gay appearance.

3. *B. dimidiata.*

Pentatoma dimidiata, Say, Heteropt. New Harmony, 7, No. 14; Complete Writings, i, 318. Erroneously printed *P. dimiata* in Say's original description.

Inhabits Texas, Indian Territory, North Carolina, Massachusetts, &c. It differs so little from the preceding species that, besides the greater convexity of the pronotum, and the more decided spotting of the venter in the latter, there is but little to separate it. The length of the joints of the antennæ is not an invariable character.

FAMILY COREIDÆ.

SUBFAMILY SPARTOCERINA.

SPARTOCERA, Lap.

S. cinnamomea.

Corecoris cinnamomeus, Hahn, Wanz. Ins. ii, 15, fig. 124; H.-Schf., *ib.* vi, 90.
Spartocerus subfulvus, Westw., Hope Catal. ii, 8.
Spartocera cinnamomea, Dallas, Brit. Mus. List, ii, 375, No. 9.
Coreus diffusus, Say, Heteropt. New Harmony, 11, No. 2.

Inhabits Texas, New Mexico, Florida, Mexico, Brazil, and Georgia.

SEPHINA, Amyot et Serv.

S. limbata.

Sephina limbata, Stål, Stettiner Ent. Zeit. xxiii, 273, No. 117.

Inhabits Mexico, Lower California, and Central America.

SUBFAMILY CHARIESTERINA.

CHARIESTERUS, Lap.

C. antennator.

Coreus antennator, Fab., Syst. Rhyng. 198, No. 33.
Gonocerus dubius, Say, Heteropt. New Harmony, 10.
Chariesterus moestus, H.-Schf., Wanz. Ins. vii, 3, fig. 681.
Chariesterus antennator, Dallas, Brit. Mus. List, ii, 510, No. 1.

Inhabits Texas, Colorado, Indian Territory, Florida, Cuba, &c., and in the Atlantic region generally.

Subfamily COREINA.

Margus, Dallas.

M. inconspicuus.

Syromastes inconspicuus, H.-Schf., Wanz. Ins. vi, 14, fig. 570.
Margus inconspicuus, Stål, Stettiner Ent. Zeit. xxiii, 303.

Inhabits Colorado, Texas, California (J. Behrens), and Mexico.

Chelinidea, Uhler.

C. vittigera.

Chelinidea vittiger, Uhler, Proc. Ent. Soc. Phila. ii, 366.
Chelinidea vittigera, Stål, Enumeratio Hemipt. i, 180.

Inhabits Idaho, Utah, Colorado, Arizona, New Mexico, California, Texas, and Western Virginia.

In Texas, according to Mr. Belfrage, it lives on a species of *Opuntia*.

Catorhintha, Stål.

1. *C. guttula.*

Lygæus guttula, Fab., Ent. Syst. iv, 162, No. 92.
Gonocerus dorsiger, Westw., Hope Catal. Hemipt. ii, 25.
Anasa dorsigera, Dallas, Brit. Mus. List, ii, 504, No. 1.
Catorhintha guttula, Stål, Hem. Fab. i, 58, No. 1.

Inhabits Texas, New Mexico, Lower California, Cuba, and Florida.

2. *C. Texana.*

Catorhintha Texana, Stål, Enumeratio Hemipt. i, 188, No. 5.

Inhabits Texas, Indian Territory, and New Mexico.

3. *C. selector.*

Catorhintha selector, Stål, Öfv. Vet. Akad. Förh. 1859, 471; Enumeratio Hemipt. i, 188, No. 4.

Inhabits Arizona, Texas, and New Mexico.

4. *C. mendica.*

Catorhintha mendica, Stål, Enumeratio Hemipt. i, 187, No. 2.

Inhabits Colorado, Indian Territory, and Dakota.

Ficana, Stål.

F. apicalis.

Gonocerus apicalis, Dallas, Brit. Mus. List Hemipt. ii, 499, No. 19.
Ficana apicalis, Stål, Enumeratio Hemipt. i, 188.

Inhabits Arizona, California, and Mexico.

Anasa, Amyot & Serv.

1. *A. tristis.*

Cimex tristis, De Geer, Mém. iii, 340, pl. 34, fig. 20.
Cimex moestus, Gmelin, Syst. Nat. i, 2168, No. 374.
Coreus rugator, Fab., Syst. Rhyng. 192, No. 4.
Oriterus destructor, Hahn, Wanz. Ins. i, 8, fig. 2.
Coreus ordinatus, Say, Journ. Acad. Phila. iv, 318, No. 2.
Gonocerus rugator, Burm., Handb. ii, 311, No. 4.
Gonocerus tristis, Dallas, Brit. Mus. List Hemipt. ii, 499, No. 17.
Anasa tristis, Stål, Hem. Fab. i, 56, No. 3.

Inhabits California, Mexico, Brazil, Texas, Arizona, Colorado, and the United States generally. Port Neuf, near Quebec (L. Provancher).

It varies very much in size, proportions, and colors, and also in the size of the punctures of the surface in conformity with its own dimen-

sions; those which are largest being most coarsely punctured, while those which are smallest are the most finely punctured.

In the larval stage, they are often guilty of cannibalism; the stronger ones sucking the juices of the weaker, and leaving only their dried empty skins to attest their places upon the squash-vines.

2. *A. Andresii.*

Coreus (Gonocerus) Andresii, Guer., in La Sagra's Cuba, Ins. 383.
Anasa lugens, Stål, Stettiner Ent. Zeit. xxiii, 301.

Inhabits Texas, New Mexico, Mexico, Cuba, Louisiana, and Southern Florida.

3. *A. armigera.*

Coreus armigerus, Say, Journ. Acad. Phila. iv, 319, No. 3.
Anasa terminalis, Dallas, Brit. Mus. List Hemipt. ii, 506, No. 4.
Anasa armigera, Stål, Hem. Fab. i, 57, No. 10; Enumeratio Hemipt. i, 192, No. 12.

Inhabits Texas, Indian Territory, Florida, North Carolina, Georgia, and Virginia. It is very rare in Maryland; only a single specimen having thus far been known to be captured in this State.

4. *A. scorbutica.*

Cimex scorbuticus, Fab., Syst. Ent. 706, No. 47.
Coreus scorbuticus, Fab., Ent. Syst. iv, 129, No. 9.
Acanthocerus nebulosus, Palisot-Beauv. Ins. Afr. et Amer. 205, pl. 12, fig. 6.
Anasa moesta, Dallas, Brit. Mus. List Hemipt. ii, 505, No. 2.
Anasa moesta, Guer., in La Sagra's Hist. de Cuba, Ins. 380.
Anasa spiniceps, Stål, Stettiner Ent. Zeit. xxiii, 300, No. 16?.
Anasa scorbutica, Stål, Hem. Fab. i, 56, No. 2.

Inhabits Texas, Indian Territory, Cuba, Mexico, Central America, and Southern Florida.

5. *A. obliqua.*

Gonocerus obliquus, Uhler, Proc. Ent. Soc. Phila. i, 23.

Inhabits California.

Thus far only a single specimen has been obtained, which is in the cabinet of the Entomological Society of Philadelphia.

PARYPHES, Burm.

P. rufo-scutellatus.

Nematopus rufo-scutellatus, G. R. Gray, in Griffith's Anim. Kingd. xv, 241, pl. 97, fig. 1.

Inhabits California, Cape Saint Lucas (J. Xanthus), and Mexico.

SUBFAMILY ALYDINA.

ALYDUS, Fab.

1. *A. eurinus.*

Lygæus eurinus, Say, Journ. Acad. Phila. iv, 324, No. 5; Complete Writings, ii, 247.
Alydus ater, Dallas, Brit. Mus. List Hemipt. ii, 478, No. 30, ♀.

Inhabits Colorado, Texas, Dakota, and throughout most of the eastern part of the United States; also in Canada. Several specimens were collected on the foot-hills of Colorado by Lieutenant Carpenter.

The western specimens are often more spotted with black than those of the Atlantic region.

2. *A. pilosulus.*

Alydus pilosulus, H.-Schf., Wanz. Ins. viii, 101, fig. 870; Dallas, Brit. Mus. List Hemipt. ii, 478, No. 28.

Inhabits Texas, Indian Territory, Illinois, New England, Maryland, &c.

This species is quite distinct from the preceding in the acuteness of the lateral angles of the pronotum and in the spines of the femora, besides the more slender form and paler colors.

3. *A. pluto.*

Alydus pluto, Uhler, Hayden's Survey of Montana, 401, No. 2.

Inhabits Colorado, Texas, Louisiana, Idaho, and Kansas.

One specimen from the foot-hills, by Lieutenant Carpenter; also several from near Denver City, sent to me by B. H. Smith.

TOLLIUS, Stål.

T. curtulus.

Alydus curtulus, Stål, Eugenies Resa, Ins. 234, No. 37.
Tollius curtulus, Stål, Enumeratio Hemipt. i, 213.

Inhabits California.

A single specimen received from James Behrens, San Francisco.

MEGALOTOMUS, Fieb.

M. quinquespinosus.

Lygæus 5-spinosus, Say, Journ. Acad. Phila. iv, 323, No. 4.
Alydus cruentus, H.-Schf., Wanz. Ins. viii, 100, fig. 838.
Megalotomus quinquespinosus, Stål, Enumeratio Hemipt. i, 214, No. 4.

Inhabits Colorado. Collected on the foot-hills by Lieutenant Carpenter.

The only specimen collected by the expedition deviates a little from the form usual to the Atlantic region, but does not offer characters of sufficient importance to make it a different species.

HYALYMENUS, Amyot & Serv.

H. tarsatus.

Alydus tarsatus, Fab., Syst. Rhyng. 250, No. 9.
Alydus recurvus, H.-Schf., Wanz. Ins. viii, 98, fig. 866.
Alydus pallens, Dallas, Brit. Mus. List Hemipt. ii, 476, No. 20.

Inhabits California, West Indies, Mexico, Cape Saint Lucas. Collected by John Xanthus.

STACHYOCNEMUS, Stål.

S. apicalis.

Alydus apicalis, Dallas, Brit. Mus. List Hemipt. ii, 479.
Stachyocnemus apicalis, Stål, Enumeratio Hemipt. i, 215.

Inhabits California, Texas, and Florida.

SUBFAMILY LEPTOCORISINA.

LEPTOCORISA, Lat.

L. tipuloides.

Cimex tipuloides, De Geer, Mém. iii, 354, pl. 35, fig. 18.
Myodocha tipuloides, Lat., Gen. Crust. et Ins. iii, 126.
Myodochus tipuloides, Oliv., Enc. Méthod. viii, 106, No. 2.
Leptocorisa tipuloides, Amyot et Serv., Hist. des Hémipt. 229, No. 1; Stoll, Punaises, fig. 162.

Inhabits Texas, Mexico, and Central America.

Protenor, Stål.

P. Belfragei.

Protenor Belfragei, Haglund, Stettiner Ent. Zeit. xxix, 162; Stål, Enumeratio Hemipt. i, 217.

Inhabits Texas, Michigan, Illinois, Wisconsin, Colorado, and occurs rarely in Maryland.

Subfamily MEROCORINA.

Corynocoris, Mayr.

C. distinctus.

Crinocerus acridioides, H.-Schf., Wanz. Ins. vi, 20, fig. 575.
Merocoris distinctus, Dallas, Brit. Mus. List Hemipt. ii, 419, 2.

Inhabits Texas, Colorado, Indian Territory, Kansas, Illinois, Missouri, New England, Pennsylvania, New Jersey, Maryland, and Florida.

Very variable in depth of color, distinctness of marking, and in the shape and proportions of the head, antennæ, and legs. In Maryland, it is often common in corners of fields adjoining woods, where the small weeds and shrubs grow luxuriantly. It may be swept from the plants in such places as late as to the middle of the month of October.

Subfamily MICTINA.

Pachylis, St. Farg. & Serv.

P. gigas.

Pachylis gigas, Burm., Handb. ii, 338, No. 3; Blanchard, Hist. Nat. Ins. 121; Dallas, Brit. Mus. List Hemipt. ii, 383.

Inhabits Arizona, New Mexico, and Mexico.

This is at once the grandest and showiest heteropterous insect yet discovered within the limits of the United States. It seems to be by no means rare in the regions where it occurs; and if its habits are similar to those of its less pretending brethren of the Eastern United States, it must make havoc with the shrubs of which it sucks the juices. The meaning of such a peculiar type of marking, including such a striking contrast of brilliant and different colors, has not yet been revealed to us. Certainly, it is not easy to see how such an arrangement of yellow lines of the corium upon a blackish ground, and of broad orange bands upon the still blacker surface of the legs, venter, and base of the third joint of the antennæ, could serve to disguise the insect so as to hide it from its enemies.

The nymph, probably in its fourth dress, is almost equally showy, but is differently painted. Its ground-color is dark steel-blue, velvety; the scutellum cadmium-orange; the venter with large broad bands along the middle; the tergum with transverse white streaks, and a row of short white lines on the middle, with a series of carmine spots each side of the middle line, and with the femora and tibiæ banded with cadmium, but with entirely blue-black antennæ.

These statements are introduced here to suggest to those who are favorably situated the importance of noting the manner of life of these exceedingly interesting insects.

Mozena, Amyot & Serv.

1. *M. lunata.*

Archimerus lunatus, Burm., Handb. ii, 322, No. 2; H.-Schf., Wanz. Ins. vi, 24, fig. 580.
Mozena lunata, Stål, Enumeratio Hemipt. i, 134.

Inhabits Mexico, Texas, and New Mexico.

2. *M. lineolata.*

Archimerus lineolatus, H.-Schf., Wanz. Ins. vi, 25, fig. 581.
Mozena lineolata, Stål, Enumeratio Hemipt. i, 134, No. 4.

Inhabits Arizona, California, and Mexico.

In some of the less mature specimens, the apical joint is not fuscous, and the connexivum lacks the blackish spots.

3. *M. obtusa.* New sp.

Form similar to that of *M. lineolata;* dark grayish-fuscous, or pale brownish in less mature individuals. Head wrinkled, grayish pubescent, a little granulated behind the eyes; the cheeks anteriorly and the bucculæ pale cinnamomeous; antennæ moderately slender, the basal joint grayish pubescent, the second and third subequal, pale orange, the apical joint fuscous; rostrum reaching behind the anterior coxæ, infuscated, the apex piceous. Pronotum punctured with fuscous, transversely wrinkled, coated with grayish prostrate pubescence, the interspaces of the rugæ yellowish-brown; lateral angle sublunately prominent, not slenderly produced, barely curved forward, blunt, but subacuminate on the extreme tip; transverse ridge near the base very distinct, the lateral margins anterior to the prominent angles sinuated, and anterior to this unevenly serrated. Scutellum coarsely, remotely punctured, yellowish at tip. Corium dull fuscous, remotely punctured, wrinkled, the disk a little sprinkled with whitish, and the subapex with a large uneven whitish patch; membrane bronzed blackish. Legs reddish-brown, sericeous pubescent; the tarsi and tibiæ dark brown or piceous; posterior femora with a triple series of pale granules on the upper side, and with a double series of short spines beneath; tibiæ of the male stout, and a little bent outward, on the inferior middle with a stout tooth, and beyond this a series of smaller teeth extending to the tip, the tip obliquely truncated, the ridges of the under side granulated. Venter minutely punctured and rugulose, each side with a series of oblique, smooth, whitish streaks; connexivum with a square, pale spot at the base of each segment. Genital segment of the male indented each side near the tip. Female with more slender, but bent, and subprismatic posterior tibiæ.

Length, 17 to 19 millimeters. Width between the angles of pronotum, 6½ to 7 millimeters. Width at base of hemelytra, 6 millimeters. Width of abdomen, 7½ millimeters.

Inhabits Texas (G. W. Belfrage); and collected in the region of the Rio Pecos River, New Mexico, by Captain (now General) Pope.

This species must approach the *M. luridus*, Dallas, of Honduras, but it lacks the prominent and acute lateral angles of the pronotum described by him; also, the angles are not infuscated, and the sides of the abdomen are not black, but spotted.

It is a neat and compact-looking little species, and serves to adorn this Mexican and Central American group of Coreoids which overlap our territory.

XUTHUS, Stål.

X. auriculatus.

Capaneus auriculatus, Stål, Stettiner Ent. Zeit. xxiii, 290.
Xuthus auriculatus, Stål, Enumeratio Hemipt. i, 136.

Inhabits Mexico, Texas, and New Mexico.

One damaged specimen was examined by me in the collection brought by Dr. Berlandier from the vicinity of Matamoras, Mexico.

This species exhibits a marked contrast to all others of the group in the widely-produced sides of the pronotum, which are drawn out into flattened and almost truncated square lobes.

Archimerus, Burm.

A. calcarator.

Coreus calcarator, Fab., Syst. Rhyng. 192, No. 3.
Coreus alternatus, Say, Journ. Acad. Phila. iv, 317, No. 1.
Archimerus squalus, Burm., Handb. ii, 321.
Piezogaster albonotatus, Amyot et Serv., Hist. des Hémipt. 197.
Archimerus rubiginosus, H.-Schf., Wanz. Ins. vi, 83.
Archimerus muticus, H.-Schf., Wanz. Ins. vi, 52, fig. 612.
Archimerus calcarator, Stål, Hemipt. Fab. i, 47.

Inhabits Colorado. Collected on the foot-hills by Lieutenant Carpenter. Also found in Texas, Indian Territory, Wisconsin, Illinois, Michigan, and the Atlantic region generally.

Sagotylus, Mayr.

S. confluentus.

Coreus confluentus, Say, Heteropt. New Harmony, 11, No. 1.
Crinocerus triguttatus, H.-Schf., Wanz. Ins. vi, 86, fig. 656.
Mictis? triguttata, Dallas, Brit. Mus. List Hemipt. ii, 402, No. 45.

Inhabits Arizona, California, Mexico, and Lower California.

Euthoctha, Mayr.

E. galeator.

Coreus galeator, Fab., Syst. Rhyng. 191, No. 2.
Crinocerus tibialis, H.-Schf., Wanz. Ins. vi. 21, fig. 576.
Crinocerus galeator, Dallas, Brit. Mus. List Hemipt. ii, 408, No. 4.
Euthoctha galeator, Stål, Hemipt. Fab. i, 49, No. 1.

Inhabits Texas, Kansas, Nebraska, Illinois, Wisconsin, Michigan, and the Atlantic region generally.

Subfamily ACANTHOCEPHALINA.

Acanthocephala, Lap.

A. declivis.

Anisoscelis declivis, Say, Insects of Louisiana, 10; Complete Writings, i, 305.
Diactor alatus, Burm., Handb. ii, 334.
Rhynuchus declivis, Say, Heteropt. New Harmony, 12, No. 4.
Metapodius thoracicus, Dallas, Brit. Mus. List Hemipt. ii, 428.

Inhabits Texas, New Mexico, California, Mexico, Florida, Central America, Lower California, and Arizona.

This species varies greatly in size, in the shape and acuteness of the pronotal wings, in the number of spines of the femora, in the width and shape of the expansions of the tibiæ, and in the color of the antennæ. Colossal specimens from South Carolina and Florida measure as much as 34 millimeters in length. In the less mature state, the antennæ are entirely reddish-cinnamomeous. Old specimens are dark fuscous, powdered beneath with whitish.

Metapodius, Westw.

1. *M. femoratus.*

Cimex femoratus, Fab., Syst. Ent. 708, No. 55.
Lygæus femoratus, Fab., Ent. Syst. iv, 137, No. 10.
Anisoscelis nasulus, Say, Insects of Louisiana, 10; Complete Writings, i, 327.
Rhynuchus nasulus, Say, Heteropt. New Harmony, 13, No. 5.
Metapodius obscurus, Westw., in Hope Catal. Hemipt. ii, 15.
Metapodius femoratus, Dallas, Brit. Mus. List Hemipt. ii, 430, No. 5.
Lygæus femoratus, Wolff, Icones Cim. 195, fig. 189.

Inhabits Texas, Indian Territory, Florida, Louisiana, and North and South Carolina

This is the analogue of the South American *M. suratus*, and, like the other forms of the genus, becomes much more darkly-colored in the fully-matured condition, and the posterior tibiæ are widely different in the two sexes.

2. *M. granulosus.*

Metapodius granulosus, Dallas, Brit. Mus. List Hemipt. ii, 430, No. 7.
Diactor alatus, H.-Schf., Wanz. Ins. vi, 53, fig. 613.
Metapodius Thomasii, Uhler, Hayden's Survey of Montana, 399, No. 1.

Inhabits Texas, Arizona, Mexico, and San Diego, Cal.

3. *M. terminalis.*

Metapodius terminalis, Dallas, Brit. Mus. List, ii, 431, No. 10; Stål, Enumeratio Hemipt. i, 151, No. 10.

Inhabits Texas, Indian Territory, Louisiana, Missouri, Illinois, and the Atlantic region generally from Massachusetts to Florida.

In Maryland, it occurs, sometimes in large numbers, on the branches and twigs of bushes on the borders of oak-woods, in September and early October.

The immature female is often cinnamon-brown, and has the entire antennæ reddish-cinnamon color. In the fully-colored specimens of both sexes, the antennæ are fuscous, with the apical joint orange.

SUBFAMILY ANISOSCELIDINA.

LEPTOGLOSSUS, Guer.

L. phyllopus.

Cimex phyllopus, Linn., Syst. Nat. ed. 12, i, 731, No. 113.
Lygæus phyllopus, Fab., Ent. Syst. iv, 139.
Anisoscelis albicinctus, Say, Heteropt. New Harmony, 12, No. 2; Wolff, Icones Cim. 196, fig. 190.
Anisoscelis confusa, Dallas, Brit. Mus. List Hemipt. ii, 453, No. 4.
Theognis phyllopus, Mayr, Novara Reise, Hemipt. 103.
Leptoglossus albicinctus, Stål, Hemipt. Fab. i, 52, No. 5.
Anisoscelis phyllopus, Burm., Handb. ii, 332, No. 5; Westw., in Hope Catal. ii, 16.

Inhabits Texas, Arizona, Indian Territory, Mexico, Missouri, Louisiana, and the Southern States generally.

2. *L. zonatus.*

Anisoscelis zonata, Dallas. List of Hemipt. ii, 452, No. 3.
Leptoglossus zonatus, Stål, Enumeratio Hemipt. i, 162, No. 6.

Inhabits Arizona, California, Mexico, and Yaqui River (Dr. E. Palmer).

3. *L. corculus.*

Anisoscelis corculus, Say, Heteropt. New Harmony, 12, No. 1; Complete Writings, i, 326.
Theognis excellens, Mayr, Verhandl. zool.-botan. Gesell. Wien, xv, 434.

Inhabits Arizona, California, Florida, Tennessee, and Maryland. The western specimens are paler-colored than those from the southeast. One specimen was picked up in the city of Baltimore in June.

4. *L. oppositus.*

Anisoscelis oppositus, Say, Heteropt. New Harmony, 12, No. 3; Complete Writings, i, 327.
Anisoscelis tibialis, H.-Schf., Wanz. Ins. vii, 12.

Inhabits Texas, Indian Territory, North Carolina, Maryland, and Kentucky.

PTHIA, Stål.

P. picta.

Cimex pictus, Drury, Illust. i, 107, pl. 45, fig. 1.
Cimex ciliatus, Fab., Syst. Ent. 706, No. 46.
Cimex leprosus, Fab., Syst. Ent. 719, No. 112.
Cimex candelabrum, Goeze, Ent. Beytr. ii, 254, No. 2.
Cimex crenulatus, Fab., Ent. Syst. iv, 144, No. 33.
Lygæus leprosus, Fab., Ent. Syst. iv, 154, No. 65.
Lygæus dispar, Fab., Syst. Rhyng. 214, No. 43.
Alydus crenulatus, Fab., Syst. Rhyng. 250, No. 11.
Leptoscelis picta, Westw., in Hope Catal. Hemipt. ii, 17.
Anisoscelis divisus, H.-Schf., Wanz. Ins. vii, 9, fig. 685.
Anisoscelis pulverulentus, H.-Schf., Wanz. Ins. vii, 9.
Leptoscelis picta, Dallas, Brit. Mus. List Hemipt. ii, 457, No. 7.
Leptoscelis obscura, Dallas, List of Hemipt. ii, 458, No. 9.
Anisoscelis (Leptoscelis) annulipes, Guer., in La Sagra's Hist. de Cuba, Ins. 388.
Pthia picta, Stål, Hemipt. Fab. i, 53, No. 1.

Inhabits Texas, Lower California, Central America, Brazil, and the West Indies. One specimen from the Yaqui River, Mexico, collected by Dr. E. Palmer; Cuba (Professor Poey).

The enormous synonymy of this species has been occasioned by the great variability of its colors and pattern of marking. In the fresh full-colored varieties, the bright-orange bands of the pronotum contrast richly with the vivid steel-blue of the ground-color.

SUBFAMILY BERYTINA.

NEIDES, Latr.

1. *N. spinosus.*

Berytus spinosus, Say, Amer. Ent. i, pl. 14.
Neides trispinosus, Hope, Catal. Hemipt. ii, 24.

Inhabits Texas, Utah, Arizona, Nebraska, Wisconsin, Illinois, Michigan, Ohio, and the Atlantic region from Maine to Georgia.

2. *N. muticus.*

Berytus muticus, Say, Heteropt. New Harmony, 13.
Neides decurvatus, Uhler, in Hayden's Survey of Montana, 402.

Inhabits Colorado, Dakota, Washington Territory, New Hampshire, and the high mountains of North Carolina.

This is no doubt the subalpine analogue of the preceding species, and, while closely resembling it, may be at once recognized by the decurving frontal process.

SUBFAMILY PSEUDOPHLŒINA.

DASYCORIS, Dallas.

D. humilis.

Dasycoris humilis, Uhler, in Hayden's Survey of Montana, 403.

Inhabits Texas, Kansas, Colorado, California, and Arizona.

SCOLOPOCERUS, Uhler.

S. secundarius.

Scolopocerus secundarius, Uhler, in Lieutenant Wheeler's Survey of Arizona.

Inhabits Arizona. Nymph from Colorado, collected by B. H. Smith.

CERALEPTUS, Costa.

C. americanus.

Ceraleptus americanus, Stål, Enumeratio Hemipt. i, 219.

Inhabits Texas, California, Arizona, and Mexico.

This species varies greatly in size and in the thickness of the antennæ, and somewhat in colors and distinctness of markings.

The less mature specimens are pale dull ochreous, faintly shaded with black, and with the black of the connexivum obsolete. The old specimens are almost black; the fine deep punctures of the surface are quite black; the antennæ are wholly black, and vary in the amount of erect pubescence upon the joints, and in such specimens the pale bands of the connexivum are very distinct.

Subfamily RHOPALINA.

Harmostes, Burm.

1. *H. reflexulus.*

Syromastes reflexulus, Say, Heteropt. New Harmony, 10, No. 1.
Harmostes costalis, H.-Schf., Wanz. Ins. ix, 270, fig. 992.
Harmostes virescens, Dallas, Brit. Mus. List Hemipt. ii, 520, No. 1.

Inhabits Colorado, Texas, Arizona, California, Dakota, Nebraska, Minnesota, Wisconsin, Illinois, and the Atlantic region from Maine to Florida. Foot-hills of Colorado, July to September (Lieutenant Carpenter).

2. *H. fraterculus.*

Syromastes fraterculus, Say, Heteropt. New Harmony, 10, No. 2.
Harmostes fraterculus, Stål, Enumeratio Hemipt. i, 221, No. 10.

Inhabits Texas, Indian Territory, Illinois, Georgia, and Maryland.

3. *H. serratus.*

Acanthia serrata, Fab., Ent. Syst. iv, 75, No. 32.
Coreus gravidator, Fab., Ent. Syst. iv, 133, No. 22.
Syrtis serrata, Fab., Syst. Rhyng. 123, No. 6.
Coreus gravidator, Fab., Syst. Rhyng. 199, No. 38.
Harmostes perpunctatus, Dallas, Brit. Mus. List Hemipt. ii, 521, No. 3.
Harmostes serratus, Stål, Hemipt. Fab. i, 67, No. 1.

Inhabits Arizona, Mexico, California, and Cuba.

Aufeius, Stål.

A. impressicollis.

Aufeius impressicollis, Stål, Enumeratio Hemipt. i, 222.

Inhabits Texas, Dakota, Arizona, and California.

Corizus, Fallen.

1. *C. hyalinus.*

Lygæus hyalinus, Fab., Ent. Syst. iv, 168, No. 115.
Coreus hyalinus, Fab., Syst. Rhyng. 201, No. 45.
Rhopalus truncatus, Fieber, Europ. Hemipt. 234, No. 4.
Corizus hyalinus, Stål, Hemipt. Fab. i, 68, No. 2.
Corizus viridicatus, Uhler, in Hayden's Survey of Montana, 404.

Inhabits Texas, Colorado, Nebraska, Dakota, Cuba, and Mexico.

This species is quite variable in colors, and somewhat in proportions. Specimens from Cuba and San Domingo are suffused with red and more distinctly pubescent than the others from Texas and Dakota. At the time when we described our *C. viridicatus*, the materials were not at hand in this country to connect the varieties with *C. hyalinus*, Fab. Specimens from the foot-hills of Colorado, by Lieutenant Carpenter.

2. *C. sidæ.*

Lygæus sidæ, Fab., Ent. Syst. iv, 169, No. 116.
Coreus sidæ, Fab., Syst. Rhyng. 201, No. 47.
Corizus sidæ, Signoret, Ann. Soc. Ent. France, ser. 3, vii, 95, No. 32; Stål, Hemipt. Fab. i, 69.
Rhopalus sidæ, Guer., in La Sagra's Hist. de Cuba, Ins. 385.

Inhabits Texas, Indian Territory, Arizona, Mexico, Cuba, Brazil, and Florida.

On one occasion, in the early part of June, this species occurred in considerable numbers near the city of Baltimore, but since that time not a single specimen has been captured in this vicinity.

3. *C. punctiventris.*

Corizus punctiventris, Dallas, Brit. Mus. List Hemipt. ii, 526, No. 3.
Corizus borealis, Uhler, Proc. Acad. Nat. Sci. Phila. 1861, 284.
Corizus punctiventris, Stål, Enumeratio Hemipt. i, 223, No. 8.

Inhabits Colorado, Arizona, California, Washington Territory, British America, Walrussia, Canada, Massachusetts, and south to Pennsylvania. In York County, in the latter State, I collected a few specimens, in the month of August.

It varies very much in color and in the amount of black upon the tergum, so that it seems to include the European *C. crassicornis*, Linn. One variety has the black bands of the connexivum reduced to mere points. Robert Kennicott collected specimens in the vicinity of the Mackenzie River, and also near the Yukon River. Mr. Scudder kindly gave me a specimen from the region of the Saskatchewan, and Mr. Kennicott collected others in the same locality. Unfortunately, his specimens have been lost to science by the great fire in Chicago.

Like *C. lateralis* and *C. hyalinus*, this species becomes suffused with a red color, which totally changes its appearance. This is also sometimes conspicuously the case in very soft recent specimens.

4. *C. lateralis.*

Coreus lateralis, Say, Journ. Acad. Phila. iv, 320, No. 4; Complete Writings, ii, 245, No. 4.
Corizus lateralis, Signoret, Ann. Soc. Ent. France, ser. 3, vii, 97, No. 36.

Inhabits Texas, Colorado, Kansas, Missouri, Illinois, and the Atlantic region generally.

The rufous stripe on the sides of the body underneath are sometimes changed from red to fuscous, and are occasionally obsolete.

In Maryland, it may be found by beating rank growths on the borders of woods; the first brood late in May to early in July, and a second brood in August, September, and October. It lives over winter in the adult state.

5. *C. nigristernum.*

Corizus nigristernum, Signoret, Ann. Soc. Ent. France, ser. 3, vii, 100, No. 41; Stål Enumeratio Hemipt. i, 225, No. 20.

Inhabits Arizona, Texas, Illinois, New England, New York, New Jersey, Pennsylvania, and Maryland.

LEPTOCORIS, Hahn.

L. trivittatus.

Lygæus trivittatus, Say, Journ. Acad. Phila. iv, 322, No. 2.
Leptocoris trivittatus, Stål, Enumeratio Hemipt. i, 226.

Inhabits Colorado, Arizona, San Francisco, California, Kansas, Missouri, and Mexico.

JADERA, Stål.

J. hæmatoloma.

Leptocoris hæmatoloma, H.-Schf., Wanz. Ins. viii, 103, fig. 873.
Serinetha hæmatoloma, Dallas, Brit. Mus. List; ii, 463, No. 17.
Lygæus (Serinetha) hæmatolomus, Guer., in La Sagra's Hist. de Cuba, Ins. 393.

Inhabits Texas, Colorado, Arizona, California, Cuba, and Mexico.

There is a form of this with rudimentary wing covers, which is moderately common in Texas, Arizona, and Cuba.

FAMILY LYGÆIDÆ.

LYGÆUS, Fab.

1. *L. turcicus.*

Lygæus turcicus, Fab., Syst. Rhyng. 118, No. 61.
Lygæus (Graptolomus) turcicus, Stål, Hemipt. Fab. i, 73, No. 10.

Inhabits Texas, Indian Territory, Illinois, Missouri, and the Atlantic and Gulf regions throughout.

2. *L. reclivatus.*

Lygæus reclivatus, Say, Journ. Acad. Phila. iv, 321, No. 1; Complete Writings, ii, 245.
Lygæus (Graptolomus) reclivatus, Stål, Enumeratio Hemipt. iii, 107.

Inhabits Colorado, Texas, California, Arizona, New Mexico, Kansas, Dakota, Oregon, and Washington Territory.

This form is placed apart provisionally from *L. turcicus,* Fab., merely because the full history of the species has not yet been elaborated. So far as the evidence from the Atlantic region goes, it is merely one of the forms of that species. The dusky variety, however, has not yet been discovered in the eastern regions of the United States. It lives in numbers, like its congeners, upon the species of *Asclepias.*

3. *L. costalis.*

Lygæus costalis, H.-Schf., Wanz. Ins. vii, 22, fig. 706.
Lygæus (Graptolomus) costalis, Stål, Enumeratio Hemipt. iv, 107, No. 17.

Inhabits Arizona, Texas, California, and Mexico.

Sufficient acquaintance with the nature of this form may establish it to be the form of *L. turcicus* dependent upon the table-lands of Southwestern North America.

4. *L. Kalmii.*

Lygæus (Graptolomus) Kalmii, Stål, Enumeratio Hemipt. iv, 107, No. 19.

Inhabits California, Mexico, and Eastern North America.

This is a variety still nearer than the preceding to *L. turcicus,* but differing from it in the amount of black on the hemelytra, and in having the membrane margined with white. It is retained here for the present merely in deference to the views of Dr. Stål.

5. *L. truculentus.*

Lygæus (Graptolomus) truculentus, Stål, Stettiner Ent. Zeit. xxiii, 308.

Inhabits California.

ONCOPELTUS, Stål.

1. *O. guttas.*

Lygæus gutta, H.-Schf., Wanz. Ins. vii, 20, fig. 703.
Oncopeltus gutta, Stål, Enumeratio Hemipt. iv, 101, No. 4.

Inhabits California, Arizona, and Mexico.

2. *O. varicolor.*

Lygæus varicolor, Fab., Ent. Syst. iv, 149, No. 49.
Lygæus alternans, H.-Schf., Wanz. Ins. ii, 20, fig. 704.
Oncopeltus varicolor, Stål, Hemipt. Fab. i, 70; Enumeratio Hemipt. iv, 102, No. 6

Inhabits California, Mexico, Central America, Brazil, &c.

ERYTHRISCHIUS, Stål.

1. *E. sandarachatus.*

Lygæus sandarachatus, Say, Heteropt. New Harmony, 13.
Lygæus unifasciatus, H.-Schf., var., Wanz. Ins. viii, 105, fig. 376.
Erythrischius sandarachatus, Stål, Enumeratio Hemipt. iv, 103.

Inhabits California, Mexico, &c.

2. *E. fasciatus.*

Lygæus aulicus, H.-Schf., Wanz. Ins. vi, 76, fig. 646.
Lygæus fasciatus, Dallas, Brit. Mus. List, ii, 538, No. 17.
Erythrischius fasciatus, Stål, Enumeratio Hemipt. iv, 103, No. 14.

Inhabits Arizona, Texas, Mexico, and the Atlantic region generally. In Maryland, it is common on the purple *Asclepias*.

MELANOPLEURUS, Stål.

1. *M. Belfragii.*

M. Belfragii, Stål, Enumeratio Hemipt. iv, 109, No. 34.

Inhabits Texas.

2. *M. bistriangularis.*

Lygæus bistriangularis, Say, Heteropt. New Harmony, 14, No. 3.
Lygæus marginellus, Dallas, Brit. Mus. List, ii, 548, No. 51.
Lygæus vicinus, Dallas, Brit. Mus. List, ii, 549, No. 52.
Melanopleurus bistriangularis, Stål, and *M. marginellus*, Stål, Enumeratio Hemipt. iv, 109.

Inhabits Texas, Mexico, Arizona, California, and Central America.

OCHROSTOMUS, Stål.

1. *O. pyrrhopterus.*

Ochrostomus pyrrhopterus, Stål, Enumeratio Hemipt. iv, 110, No. 40.

Inhabits Texas and Mexico.

2. *O. lineola.*

Lygæus lineola, Dallas, Brit. Mus. List, ii, 549, No. 53.
Ochrostomus lineola, Stål, Enumeratio Hemipt. iv, 110.

Inhabits Texas, New Mexico, Florida, and Georgia.

MELANOCORYPHUS, Stål.

1. *M. pusio.*

Melanocoryphus pusio, Stål, Enumeratio Hemipt. iv, 112.

Inhabits Texas.

2. *M. obscuripennis.*

Melanocoryphus obscuripennis, Stål, Enumeratio Hemipt. iv, 112, No. 3.

Inhabits Texas.

3. *M. bicrucis.*

Lygæus bicrucis, Say, Journ. Acad. Phila. iv, 322, No. 3.
Lygæus flavomarginellus, Stål, Eugenies Resa, Ins. 241.
Lygæus rubescens, Stål, Rio Hemipt. Fauna, i, 37.
Lygæus bitransversus, Signoret, Ann. Soc. Ent. France, ser. 3, viii, 947.
Melanocoryphus bicrucis, Stål, Enumeratio Hemipt. iv, 113, No. 6.

Inhabits California (J. Behrens), Nevada, New Mexico, Texas, Louisiana, Kansas, Missouri, and the Southern States east into Georgia and Florida. It is rare in Maryland, and extends as far south as Rio Janeiro, Brazil.

Its food-plant has not yet been reported, and it is hoped that western collectors will direct their attention to its habits, and make them known.

4. *M. facetus.*

Lygæus facetus, Say, Heteropt. New Harmony, 13, No. 2.
Melanocoryphus facetus, Stål, Enumeratio Hemipt. iv, 113, No. 9.

Inhabits Texas, Mexico, California, Florida, New Jersey, Louisiana, the sea-coast of Maryland, &c. One specimen from the foot-hills of Colorado, collected by Lieutenant Carpenter in July.

5. *M. admirabilis.*

Lygæus admirabilis, Uhler, in Hayden's Survey of Montana, 405, No. 5.

Inhabits Colorado.

6. *M. lateralis.*

Lygæus lateralis, Dallas, Brit. Mus. List, ii, 550, No. 58.
Melanocoryphus lateralis, Stål, Enumeratio Hemipt. iv, 113, No. 12.

Inhabits Texas and Mexico.

7. *M. mimulus.*

Melanocoryphus (*Ochrimnus*) *mimulus*, Stål, Enumeratio Hemipt. iv, 113, No. 15.

Inhabits Texas.

SUBFAMILY NYSIINA.

NYSIUS, Dallas.

1. *N. californicus.*

Nysius californicus, Stål, Eugenies Resa, Hemipt. 242, No. 56.

Inhabits Texas, California, Arizona, Colorado, Dakota, South Carolina, and Maryland. Rare in the latter State, but common in California and Arizona.

2. *N. angustatus.*

Nysius angustatus, Uhler, in Hayden's Survey of Montana, 406, No. 2.

Inhabits Dakota, California, Texas, Kansas, &c. Collected above timber-line on the mountains of Colorado, in June, by Lieutenant Carpenter.

3. *N. grœnlandicus.*

Lygæus grœnlandicus, Zett., Insecta Lapponica, 262, No. 3.
Nysius grœnlandicus, Stål, Enumeratio Hemipt. iv, 3.

Inhabits Greenland, Labrador, British America, and Unalaska.

Sufficiently large series for full comparison may show that this and the preceding are only varieties of a single species, in which case the latter name will have priority.

Belonochilus, Uhler.

B. numenius.

Lygæus numenius, Say, Heteropt. New Harmony, 15, No. 9.
Belonochilus numenius, Uhler, Proc. Boston Soc. Nat. Hist. 1871, p. 12.

Inhabits Arizona, Ohio, Illinois, and New England. Very rare in Maryland.

Orsillus, Dallas.

O. scolopax.

Lygæus scolopax, Say, Heteropt. New Harmony, 15, No. 8.

Inhabits Texas, Kansas, Missouri, Nebraska, Illinois, and Maine. Common upon dry grass and sedges near Portland, Me., in the month of August. Met with in Maryland, a few miles south of Baltimore, while I was sweeping stubble-fields in August and September. Usually, it is rare in this region.

Subfamily CYMINA.

Ischnorhynchus, Fieb.

I. didymus.

Lygæus didymus, Zett., Vet. Ak. Handl., 1819, 71, No. 20.
Lygæus geminatus, Say, Heteropt. New Harmony, 14, No. 7.
Cymus franciscanus, Stål, Eugenies Resa, Ins. 252, No. 84.
Ischnorhynchus didymus, Stål, Enumeratio Hemipt. iv, 124, No. 1.

Inhabits California, Texas, Kansas, Nebraska, Illinois, the Eastern United States, and Canada. Europe and Siberia.

In Maryland, it is found sparingly upon bushes and shrubbery near the edges of woods.

Cymus, Hahn.

1. *C. angustatus.*

Cymus angustatus, Stål, Enumeratio Hemipt. iv, 126, No. 2.

Inhabits Texas, Kansas, and the Atlantic region.

2. *C. breviceps.*

Cymus breviceps, Stål, Enumeratio Hemipt. iv, 127, No. 4.

Inhabits Texas and the Southern States.

Cymodema, Spin.

C. tabida.

Cymodema tabida, Spinola, Essai, 213.
Cymodema tabida, Fieb., Europ. Hemipt. 204.

Inhabits California, Texas, New Jersey, and Maryland, in July and August, upon undergrowth in thin woods.

After close comparison with specimens from Europe, I do not find differences of sufficient importance to separate the two forms.

Subfamily BLISSINA.

Ischnodemus, Fieb.

I. falicus.

Lygæus falicus, Say, Heteropt. New Harmony, 15, No. 10; Complete Writings, i, 331.
Micropus falicus, Signoret, Ann. Soc. Ent. France, 3d ser. v, 27, pl. 2, fig. 5.

Inhabits Texas, Dakota, Kansas, Louisiana, and the United States generally east of the Mississippi basin. In Maryland, it passes the

winter beneath stones in sheltered places, and may be swept from plants in damp situations in June and July.

Specimens from the sea-coasts of Maryland and North Carolina sometimes attain to a size twice as great as that commonly found farther inland. Moisture combined with warmth seems most favorable to its greatest development.

BLISSUS, Burm.

B. leucopterus.

Lygæus leucopterus, Say, Heteropt. New Harmony, 14, No. 5; Complete Writings, i, 329.
Micropus leucopterus, Signoret, Ann. Soc. Ent. France, 3d ser. v, 31, pl. 2, fig. 11.

Inhabits Texas, California, Kansas, Nebraska, Wisconsin, Minnesota, Illinois, Michigan, and generally throughout the Atlantic region.

The short-winged form seems to be more common in New England than in the Southern States.

SUBFAMILY GEOCORINA.

GEOCORIS, Fallen.

1. *G. Scudderi.*

Geocoris Scudderi, Stål, Enumeratio Hemipt. iv, 135, No. 7.

Inhabits Texas.

2. *G. punctipes.*

Salda bullata var. *punctipes*, Say, Heteropt. New Harmony, p. 19. Complete Writings, i, 336.
Ophthalmicus luniger, Fieb., Wien. Entom. Monats. v, 269, No. 4.

Inhabits Texas, Indian Territory, Colorado, and the Atlantic region.

3. *G. bullata.*

Salda bullata, Say, Heteropt. New Harmony, 18, No. 2; Complete Writings, i, 336.
Ophthalmicus borealis, Dallas, Brit. Mus. List Hemipt. ii, p. 585, No. 8.

Inhabits Illinois, Canada, &c. One specimen from the foot-hills of Colorado, in July, by Lieutenant Carpenter. Very rare in the vicinity of Baltimore.

The color of the legs, antennæ, rostrum, head, and pleural pieces vary considerably in the amount of black or piceous color upon them. The legs are occasionally destitute of black, or they have only a few black points, or they may be black, excepting only the base and tip of femora.

4. *G. pallens.*

Geocoris pallens, Stål, Eugenies Resa, Hemipt. 250; Öfv. Vetensk. Akad. Förhandl. 1854, 236; Enumeratio Hemipt. iii, 136, No. 13.

Inhabits California.

This will probably prove to be only a form of the preceding species; but at present, in the absence of a sufficient series for comparison, it will be best to keep the two separate.

5. *G. tristis.*

Geocorus tristis, Stål, Öfv. Vetensk, Akad. Forhandl. 1854, 236; Eugenies Resa, Hemipt. 249, No. 77.

Inhabits California.

6. *G. piceus.*

Salda picea, Say, Heteropt. New Harmony, 18, No. 1; Complete Writings, i, 336, No. 1.

Inhabits Colorado, Illinois, New York, Massachusetts, Pennsylvania; and a single specimen only, thus far, from Maryland.

7. *G. uliginosus.*

Salda uliginosa, Say, Heteropt. New Harmony, 19, No. 3; Complete Writings, i' 337.
Ophthalmicus niger, Dallas, Brit. Mus. List Hemipt. ii, 586, No. 9.
Ophthalmicus lateralis, Fieb., Wien. Entom. Monats. v, 271, No. 9.

Inhabits Texas, Kansas, Dakota, Missouri, Illinois, New England, New Jersey, Maryland, and Georgia.

8. *G. limbatus.*

Geocoris limbatus, Stål, Enumeratio Hemipt. iv, 136, No. 16.

Inhabits Dakota, Illinois, Massachusetts, and New Jersey.

Subfamily PACHYGRONTHINA.

Phlegyas, Stål.

P. annulicrus.

Phlegyas annulicrus, Stål, Enumeratio Hemipt. iv, 138.

Inhabits Texas, South Carolina, and New Jersey.

Oedancala, Amyot & Serv.

1. *O. dorsalis.*

Pamera dorsalis, Say, Heteropt. New Harmony, 17, No. 8.
Oedancala dorsilinea, Amyot & Serv., Hemipt. 258, pl. 12, fig. 6.

Inhabits Texas, Indian Territory, and the Eastern United States from Maine to Florida; common in Maryland.

2. *O. crassimana.*

Lygæus crassimanus, Fab., Syst. Rhyng. 233, No. 145.
Oedancala crassimana, Stål, Enumeratio Hemipt. iv, 139, No. 3.

Inhabits Texas, Georgia, Maryland, and New Jersey.

3. *O. Cubana.*

Oedancala Cubana, Stål, Enumeratio Hemipt. iv, 139, No. 1.

Inhabits Texas, Cuba, and Florida.

Subfamily OXYCARENINA.

Crophius, Stål.

C. Bohemani.

Cymus Bohemani, Stål, Eugenies Resa, Hemipt. 251.
Crophius Bohemani, Stål, Enumeratio Hemipt. iv, 142, No. 2.

Inhabits California and Arizona.

Subfamily MYODOCHINA.

Ptochiomera, Say.

1. *P. nodosa.*

Ptochiomera nodosic, Say, Heteropt. New Harmony, 18; Complete Writings, i, 335, No. 9.
Aphanus clavatus, Dallas, Brit. Mus. List Hemipt. ii, 560, No. 5.
Plociomera nodosa, Stål, Enumeratio Hemipt. iv, 153, No. 3.

Inhabits Texas, Missouri, Louisiana, Florida, Georgia, &c.

In Maryland, it is common beneath stones, and is one of the first to become active in spring when the severe cold of winter is past. In the autumn, it may be met with beneath the stems of dried or drying plants and bushes which have dropped their leaves.

The short-winged form is common in the granitic and primitive regions of this State, but it is generally full-winged in the newer and more southern portions of this region, while farther south it is always (?) full-winged.

2. *P. minima.*

Lygæus (Beosus) minimus, Guer., in La Sagra's Hist. de Cuba, Ins. 398.
Plociomera minima, Stål, Enumeratio Hemipt. ii, 153.

Inhabits Cuba, Florida, Louisiana, and Texas.

3. *P. puberula.*

Plociomera puberula, Stal, Enumeratio Hemipt. iv, 153, No. 8.

Inhabits Texas.

4. *P. fuscicornis.*

Plociomera fuscicornis, Stål, Enumeratio Hemipt. iv, 152, No. 2.

Inhabits Texas.

Cnemodus, H.-Schf.

C. mavortius.

Astemma mavortia, Say, Heteropt. New Harmony, 19; Complete Writings, i, 337.
Cnemodus brevipennis, H.-Schf., Wanz. Ins. ix, 184, fig. 948.

Inhabits Texas, Missouri, and the Atlantic region throughout. In Maryland, it is common beneath stones and rubbish from March to November.

Carpilis, Stål.

C. ferruginea.

Carpilis ferruginea, Stål, Enumeratio Hemipt. iv, 153, No. 1.

Inhabits Texas and New Mexico.

Ligyrocoris, Stål.

1. *L. sylvestris.*

Cimex sylvestris, Linn., Faun. Suec. 256.
Plociomerus sylvestris, Fieb., Europ. Hemipt. 171.
Plociomerus diffusus, Uhler, Proc. Boston Soc. Nat. Hist. 1871, 9.
Pamera contracta, Say, Heteropt. New Harmony, 16, No. 2.

Inhabits almost the whole continent of North America, and not uncommon in various parts of continental Europe.

We have examined specimens which were collected in British and

Russian America, by Robert Kennicott; from near Quebec, by the Abbé Provancher; from the foot-hills of Colorado, by Lieutenant Carpenter; and I have myself collected numerous specimens in various parts of Eastern Maine, Massachusetts, Rhode Island, Connecticut, Pennsylvania, New Jersey, and Maryland. In the latter State, it may be swept from grassy wild spots adjacent to *Sphagnum* swamps. It occurs also on the high mountains of North Carolina.

2. *L. constrictus.*

Pamera constricta, Say, Heteropt. New Harmony, 15, No. 1; Complete Writings, i, 332.
Beosus abdominalis, Guer., in La Sagra's Hist. de Cuba, Ins. 397.
Plociomera piligera, Stål, Stettin. Ent. Zeit. xxiii, 312.

Inhabits Mexico, Cuba, Florida, Louisiana, Texas, and the Atlantic region from Massachusetts southward.

The spines beneath the anterior femora are variable in size and number; and much allowance must be made for the color and pattern of marking of specimens, as much depends upon their maturity.

I have collected specimens on the Atlantic peninsula of Maryland and Virginia, which had been mutilated before attaining maturity. Such specimens had one side, or some part of the pronotum, abdomen, or wing-covers, indented, distorted, or forced away; and, in two or more instances, the antenna of one side was much shortened and thickened, causing the basal and middle joints to be abnormally short. The females are proportionally shorter and stouter than the males; but, in this respect, there is also much variation. Some males are almost as robust as the females.

MYODOCHA, Latr.

M. serripes.

Myodochus serripes, Oliv., Encyc. Méthod. viii, 106.
Myodocha petiolata, Say, Heteropt. New Harmony, 19 [erroneously reprinted by Dr. Fitch, in Trans. N. Y. State Agric. Soc., *M. opetilata*]; Complete Writings, i, 337.
Chiroleptes raptor, Kirby, Fauna Bor.-Amer. iv, 281.
Myodocha serripes, Amyot et Serv., Hemipt. 258; H.-Schf., Wanz. Ins. ix, 213, fig. 966.

Inhabits Texas, Mexico, Indian Territory, Illinois, Missouri, Louisiana, and the Atlantic region generally.

In Maryland, it lives beneath stones in the spring and early summer. When the warm weather sets in, it spreads into the adjoining meadows and grassy spots to find sustenance. In the autumn, it may again be found beneath stones and rubbish; and, as the severe weather approaches, it hybernates in crevices of bark, beneath leaves, and under the stones in sheltered places.

HERÆUS, Stål.

1. *H. plebejus.*

Heræus plebejus, Stål, Enumeratio Hemipt. iv, 147, No. 2.

Inhabits Texas, Arizona, New Jersey, &c.

2. *H. insignis.*

Heræus insignis, Uhler, in Hayden's Survey of Montana, 407.

Inhabits Utah, Colorado, Minnesota, and Canada.

Pamera, Say.

1. *P. longula.*

Rhyparochromus longulus, Dallas, Brit. Mus. List, ii, 578, No. 50.
Pamera longula, Stål, Enumeratio Hemipt. iii, 148, No. 5.

Inhabits Cuba, Florida, Texas, Mexico, Louisiana, and the Southern States.

2. *P. parvula.*

Rhyparochromus parvulus, Dallas, Brit. Mus. List, ii, 576, No. 45.
Plociomerus Amyoti, Guer., in La Sagra's Hist. de Cuba, Ins. 400.
Plociomerus vinulus, Stål, Eugenies Resa, Hemipt. 246, No. 66.

Inhabits Cuba, Hayti, Florida, Texas, Mexico, Georgia, and North Carolina. In the latter State, it occurs upon the Black Mountain range. It is abundant in Florida in the month of June; and, in the western part of Hayti, it occurs in small swarms upon low plants in damp spots and in gardens.

3. *P. curvipes.*

Pamera curvipes, Stål, Enumeratio Hemipt. iv, 148, No. 9.

Inhabits Texas, New Mexico, and South Carolina.

4. *P. bilobata.*

Pamera bilobata, Say, Heteropt. New Harmony, 17, No. 7; Complete Writings, i, 334, No. 7.
Rhyparochromus scutellatus, Dallas, Brit. Mus. List, ii, 575, No. 43.
Plociomerus Servillei, Guer., in La Sagra's Hist. de Cuba, Ins. 399.
Plociomerus ochroceras, Stål, Eugenies Resa, Hemipt. 245, No. 64.

Inhabits Texas, Louisiana, Florida, Georgia, South Carolina, the Black Mountain region of North Carolina, Cuba, and Mexico.

Several specimens were swept by myself from low plants in a wet spot south of Baltimore, in August.

5. *P. setosa.*

Pamera setosa, Stål, Enumeratio Hemipt. iv, 150, No. 21.

Inhabits Texas.

6. *P. nitidicollis.*

Pamera nitidicollis, Stål, Enumeratio Hemipt. iv, 150, No. 22.

Inhabits Texas.

7. *P. basalis.*

Rhyparochromus basalis, Dallas, Brit. Mus. List, ii, 575, No. 42.
Pamera basalis, Stål, Enumeratio Hemipt. iv, 152, No. 37.

Inhabits Texas, Nebraska, Minnesota, Illinois, Pennsylvania, Missouri (C. V. Riley), and Maryland. It is common near Baltimore on the soils in the region of the metamorphic rocks; living in the wheat and grass fields during spring and summer, and hybernating beneath the rocks upon the arrival of cold weather.

Ozophora, Uhler.

O. picturata.

Ozophora picturata, Uhler, Proc. Boston Soc. Nat. Hist. 1871, p. 10.

Inhabits Texas, Maryland, and Pennsylvania.

Very rare near Baltimore; obtained from spots covered with rank growths late in July.

TEMPYRA, Stål.

T. biguttula.

Tempyra biguttula, Stål, Enumeratio Hemipt. iv, 157.

Inhabits Texas.

TRAPEZONOTUS, Fieb.

1. *T. nebulosus.*

Lygæus nebulosus, Fallen, Mon. Cim. 65, No. 7.
Pamera fallax, Say, Heteropt. New Harmony, 17, No. 6; Complete Writings, i, 334.
Trapezonotus nebulosus, Fieb., Europ. Hemipt. 190.

Inhabits Europe, Texas, Colorado, Montana, Illinois, British America, Canada, New England, and California.

2. *T. rufipes.*

Trapezonotus rufipes, Stål, Enumeratio Hemipt. iv, 159, No. 2.

Inhabits Texas.

EREMOCORIS, Fieb.

E. ferus.

Pamera fera, Say, Heteropt. New Harmony, 16, No. 4.
Rhyparochromus borealis, Dallas, Brit. Mus. List, ii, 565.

Inhabits Texas, California, Montana, Illinois, New England, New York, Canada, South Carolina, White Mountains (Mr. Samuel H. Scudder); very rare in Maryland.

This species varies considerably in the shape of the pronotum, in the relative length of its two lobes, and in the width of the lateral margins. The legs also vary from pale piceous to deep black.

MEGALONOTUS, Fieb.

M. unus.

Pamera una, Say, Heteropt. New Harmony, 16, No. 5.

Inhabits Texas, Maryland, Pennsylvania, and New York.
One specimen captured, October 22, near Baltimore.

EMBLETHIS, Fieb.

E. arenarius.

Cimex arenarius, Linn., Fauna Suecica, 955.
Emblethis arenarius, Fieb., Europ. Hemipt. 198, No. 2.

Inhabits Europe, where it lives on sandy spots about the roots of plants. In Colorado, it seems to be quite common; also from Texas, Illinois, Nevada, Massachusetts, and Georgia.

CISTALIA, Stål.

C. Signoretii.

Platygaster Signoretii, Guer., in La Sagra's Hist. de Cuba, Ins. 296.
Cistalia Signoretii, Stål, Enumeratio Hemipt. iv, 165.

Inhabits Texas, Cuba, Nevada, and California.

CRYPHULA, Stål.

C. parallelogramma.

Cryphula parallelogramma, Stål, Enumeratio Hemipt. iv 165.

Inhabits Texas.

Subfamily HETEROGASTRINA.

Phygadicus, Fieb.

P. Behrensii. New sp.

Form and general appearance of *P. urticæ*, Fieb. Bronze-black, closely pubescent. Head black, very convex, densely, somewhat coarsely, roughly punctured, the base with a small yellow point; base of the head not so much narrowed as in *P. urticæ;* antennæ stout, testaceous or pale piceous; the basal joint black, excepting at its base and tip; second joint longest, a little blackish near each end; third and fourth joints equal, the former black on the middle, the latter infuscated almost throughout; rostrum reaching behind the anterior coxæ, piceous; the apex of the first and second joints testaceous. Pronotum moderately flat, black, closely, rather coarsely punctured, less closely behind, narrower and less rounded at and behind the anterior angles than in *P. urticæ;* the lateral margins yellow, moderately sinuated; the posterior margin broadly sinuated; running forward from its middle are three short, yellow lines; humeral angles moderately prominent, black, slenderly margined with yellow. Beneath, densely hoary pubescent, opaque black; posterior margins of the pro- and meta-pleuræ, coxæ, trochanters, osteoles, and legs testaceous. Femora largely pitchy-black or pointed with black, roughly indented over the outer and inner surfaces; tibiæ on the base, middle, and apex banded with black; the chief part of the last tarsal joint and the apex of the basal joint piceous. Scutellum black, densely and finely punctured at base, more remotely and coarsely toward the apex; the apex and adjoining edge testaceous. Corium grayish testaceous, with a large blackish cloud on the disk and a black spot at tip, also a black band invading the base of the membrane, but omitting most or all of the bounding thick nervule; the punctures remote, black, moderately coarse; the clavus black, excepting its edges. Abdomen dull black, minutely, densely punctured and shagreened, the outer edge, a spot on the middle of the outer margin of the segments, the inner margins of the ovipositor valves and segments and the adjoining edges yellow; genital segments more or less rufous apically.

Length, 7 to 7½ millimeters. Width of pronotum, 1¾ to 2 millimeters.

Inhabits California (James Behrens).

To Mr. James Behrens we are indebted for this interesting representative of an eastern genus, hitherto undiscovered on the American continent. Through his indefatigable exertions much has been contributed to the knowledge of the Pacific forms of many of the groups of insects, and it is with peculiar pleasure that we signalize his services in the department of the *Hemiptera* by giving his name to this species.

Helonotus. New gen.

Aspect similar to *Henestaris.* Elongate-ovate. Head a little wider than long; the face convexly decurving; inferior cheeks tumid, separated from the superior ones by a deep groove; eyes round, very prominent, projecting wider than the fore sides of the pronotum; tylus forming a much projecting, cylindrical peak, the surface each side of it depressed; bucculæ disk-like, limited to the tip of the superior cheeks; gular surface obliquely ridged each side of the base. Rostrum stout; basal joint scarcely more than one-half the length of the throat; second joint hardly longer than the apical one; the middle joint shorter than the apical one. Antennæ stout, about as long as from the front to the

base of the pronotum; the antenniferous ridge stout and running directly down from the eye; basal joint very short, hardly reaching beyond the tip of the tylus, second longest, apical one thickest, fusiform, not quite as long as the second. Pronotum long, trapezoidal, gradually narrowing anteriorly, the transverse diameter convex, the longitudinal one feebly convex, the surface much more elevated than the plane of the corium and scutellum; collum contracted, flattened, on the under side, divided on the prosternum; plagæ placed far back on a convex ridge, which is continued to the lateral margin; behind this the surface is transversely grooved, causing the lateral margins to be sinuated; behind this to the posterior margin is a still more elevated, wider, transverse ridge; the lateral margins bluntly rounded, not recurved, deep; posterior margin truncated. Corium broad, blunt, sinuated on the posterior margin, scarcely longer than the membrane, punctate in longitudinal rows; membrane with about five long straight nervures, of which the next to the outer one is forked, and at the ends of the nervures are several small closed cells [these are sometimes absent]. Anterior femora very stout and short; the under surface rough, with a curved channel on the outer side, and a row of uneven teeth on the inner.

H. abbreviatus. New sp.

Thick, deep, long-ovate, grayish pale brown. Head coarsely, remotely punctured, the punctures deeply sunken and with raised margins; surface very uneven, depressed near the eyes, rufous or piceous; bucculæ and antennæ ochre-yellow; tylus blackish, with rows of coarse, uneven punctures; antennæ annulated with black, once on the basal joint, twice on the second, and all but the base and tip of the third blackish, the fourth rufo-piceous or fuscous. Rostrum reaching between the anterior and middle coxæ, brownish-yellow, piceous along the middle of the joints and at tip. Pronotum tawny or rust-brown, obsoletely carinated; the callosities, two short streaks adjoining the humeral angles, and sometimes a trace or two on the middle of the sides and on the anterior margin piceous; surface deeply, unevenly, coarsely punctured; humeral angles distinctly tumid, the anterior angles rectangular; lateral margins bluntly rounded; pectus and under side of head powdered with white, coarsely, rather remotely punctured; the mesosternum each side and one or more spots on the metapleura piceous. Femora black, excepting at base and tip, and a ring at base and another near the tip of tibiæ black; the tarsi faintly tinged with piceous. Scutellum tawny, tinged with rufous, infuscated and carinated on the middle line, coarsely, closely punctured. Hemelytra ochre-yellow, a little infuscated at base, the posterior, raised boundary-edge of the corium with angulated black line extending inward as far as the clavus; both corium and clavus coarsely punctured in longitudinal rows; membrane whitish. Tergum piceous-blackish or chestnut-brown, coarsely, a little remotely, punctured; connexivum with alternate quadrangular spots of whitish and black. Venter chestnut-brown or piceous, more or less tinged with rufous, erodedly, deeply, remotely punctured, the base more or less infuscated, pruinose. ♂ ♀.

Length, 3 to $5\frac{1}{4}$ millimeters. Width of pronotum, $1\frac{1}{2}$ to 2 millimeters.

Inhabits Nebraska, Missouri, Illinois, Michigan, Massachusetts, New York, Grimsby, Canada (Mr. Petit), New Jersey, Maryland, and North Carolina.

It occurs in Maryland very abundantly in places where the plants and weeds grow rank, and also on small bushes forming the undergrowth in open woods.

In Central Maryland and Eastern Pennsylvania, it may be swept from the bushes as early as the middle of May and as late as November. Occasionally, it swarms in clover-fields, and no doubt does considerable injury to that crop by withdrawing the sap from the tender heads before they have become full-blown. On the other hand, it and the common *Lygus lineolaris* and *Plagiognathus obscurus*, no doubt help to fertilize the flowers by their active movements in the heads and frequent flying from one to the other, carrying masses of pollen on their bodies and bristly legs. Sometimes these insects are literally powdered with the pollen which adheres to their bodies.

Subfamily PYRRHOCORINA.

Dysdercus, Amyot et Serv.

1. *D. mimus.*

Capsus mimus, Say, Heteropt. New Harmony, 20, No. 3; Complete Writings, 338.
Dysdercus mimus, Stål, Enumeratio Hemipt. i, 121, No. 14.

Inhabits Texas, Mexico, California, Cuba, Hayti, and Central America.

This species varies in color, but most strikingly so in the width and proportions of the head, pronotum, and abdomen, including the hemelytra.

The two varieties cited by Mr. Say belong really to this, and do not constitute a second species as indicated by Dr. Stål in the place referred to above.

In some varieties from Mexico, the head, pronotum, and corium are entirely black, and from this to the variety with only a point of black on the middle of the corium every variety occurs. In Hayti, they abound in gardens, and affect small growths in damp or low grounds. The males are in general narrower than the females.

2. *D. albidiventris.*

Dysdercus albidiventris, Stål, Öfv. Vetensk. Akad. Förh. 1854, 236; Stettiner Ent. Zeit. 23, 315 [exclusive of his reference to Say's *C. mimus*].
Dysdercus lunulatus, Uhler, Proc. Ent. Soc. Phila. i, 24.

Inhabits Mexico, Texas, California, Central America, and Panama.

This also varies in the same manner as the preceding species, and, although inhabiting some of the same localities in large numbers, it is of a larger size, and has the sides of the pronotum more deeply sinuated. One beautiful variety from California has the whole base of the pronotum back of the callosities, and the entire corium, blood-red.

3. *D. peruvianus.*

Lygæus peruvianus, Guer., Voyage de la Coquille, 178, pl. 12; fig. 16.
Dysdercus peruvianus, Stål, Enumeratio Hemipt. i, 121, No. 19.

Inhabits California, Peru, and the Sandwich Islands.

4. *D. obliquus.*

Pyrrhocoris obliquus, H.-Schf., Wanz. Ins. vii, 19, fig. 701.
Dysdercus bimaculatus, Stål, Öfv. Vetensk. Akad. Förh. 1854, 236.
Dysdercus obliquus, Stål, Enumeratio Hemipt. i, 121, No. 20.

Inhabits California, Mexico, Central America, Panama, &c.

A variety of this species lacks the two black dots of the corium.

Subfamily LARGINA.

Acinocoris, Hahn.

A. lunatus.

Cimex lunatus, Fab., Mantissa Ins. ii, 302, No. 237.
Lygæus calidus, Fab., Syst. Rhyng. 230.
Acinocoris calidus, Hahn, Wanz. Ins. ii, 114, fig. 194.
Largus interruptus, H.-Schf., Wanz. Ins. ix, 181, fig. 978.
Largus lunulatus, Burm., Handb. ii, 282, No. 1.
Largus (*Acinocoris*) *lunatus*, Stål, Enumeratio Hemipt. i, 92, No. 1.

Inhabits Brazil, Surinam, Mexico, and has been once found in California. It seems to be commou in the valley of the Amazonas.

Largus, Hahn.

1. *L. cinctus.*

Largus cinctus, H.-Schf., Wanz. Ins. vii, 6, fig. 683; Stål, Enumeratio Hemipt. i, 94, No. 11.
Capsus succinctus, var. *a*, Say, Heteropt. 20.

Inhabits Mexico, California, Oregon, Nevada, and Arizona.

This differs only in a slight degree from the following species, and will no doubt hereafter prove to be only the extreme western form of it.

2. *L. succinctus.*

Cimex succinctus, Linn., Cent. Ins. Rarior. 17, No. 44.
Cimex rubrocinctus, De Geer, Mém. iii, 339, pl. 34, fig. 19.
Lygæus succinctus, Fab., Ent. Syst. iv, 170.
Largus succinctus, H.-Schf., Wanz. Ins. vi, 78, fig. 648.

Inhabits Pennsylvania to Florida, and westward to Texas, Arizona and Southern Colorado.

The western specimens are blacker and not so brightly red-margined as those from the coasts of Georgia and Florida. In the sea islands of the latter State, a variety occurs which is of a dirty sand-red. This conforms with our experiences respecting other insects which belong to sandy regions adjacent to the sea; for example, *Œdipoda eucerata*, Harris, *Gryllus abbreviatus*, *Salda Signorete*, and many others, which are all paler and more nearly of the color of sand than their brethren who live farther inland upon the dark soils.

This genus is essentially American, and ranges between the northern warm-temperate zone and the southern warm-temperate zone. Each geographical province has one or more species. The insular and equatorial ones of the lowlands are marked with yellow spots, while the others are more uniform and plainer in their pattern.

Family PHYTOCORIDÆ.

Monalocoris, Dahlb.

M. filicis.

Cimex filicis, Linn., Syst. Nat. 718, No. 20.
Acanthia filicis, Wolff, Icon., Cim. 46, tab. 5, fig. 43.
Bryocoris filicis, Kolenati, Melet. Entom. ii, 129.
Monalocoris filicis, Fieb., Europ. Hemipt. 237; Douglas & Scott, British Hemipt. 279, pl. 10, fig. 2.

Inhabits Nebraska, Texas, Illinois, Maine, and Maryland; and Europe.

It is sometimes quite common in late summer and early autumn on several kinds of ferns.

MEGALOCERÆA, Fieb.

1. *M. debilis.*

Megalocerœa debilis, Uhlér, in Hayden's Survey of Montana, 408, No. 1.

Inhabits Colorado, Montana, and Wyoming.

2. *M. rubicunda.*

Megalocerœa rubicunda, Uhler, *ib.* 408, No. 2.

Inhabits Colorado.

TRIGONOTYLUS, Fieb.

T. ruficornis.

Miris ruficornis, Fallen, Hemipt. Suec. i, 133, No. 8.
Miris ruficornis, Douglas & Scott, British Hempt. 290, 6.
Trigonotylus ruficornis, Fieb., Eur. Hemipt. 243.

Inhabits Idaho, Colorado, Illinois, Texas, Massachusetts, and Maryland; and Europe.

It inhabits the grass and weeds in brackish marshes in Maryland, and the salt-marshes near the coast in Massachusetts.

LEPTOPTERNA, Fieb.

L. amœna.

Leptopterna amœna, Uhler, in Haydén's Survey of Montana, 409.

Inhabits Idaho and Dakota.

BRACHYTROPIS, Fieb.

B. calcarata.

Miris calcaratus, Fallen, Hemipt. Suec., 131, No. 5.
Brachytropis calcarata, Fieb., Europ. Hemipt. 241.

Inhabits Texas, Indian Territory, Illinois, Massachusetts, Canada, New Jersey, Pennsylvania, and Maryland; and Europe. Common on rank weeds in low pastures and woods.

MIRIS, Auctor.

M. instabilis. New sp.

Form and general appearance of *M. virens*, Linn. Green, greenish-testaceous, or pale dull straw-yellow, clothed with close yellow pubescence. Head broadly conical, with a blackish vitta each side, which is usually continued backward over the pronotum and scutellum to the apex of the corium; apex of the head a little upturned, the vertex densely pubescent, minutely, confluently punctured, at the base bald, impunctate, and with a central impressed line. Antennæ robust, rufous, the basal joint a little longer than the head, sometimes greenish, beset with long stiff hairs. Eyes round, prominent, in contact posteriorly with the pronotum. Rostrum reaching behind the middle coxæ. Pronotum convex behind, finely, deeply, and in part confluently punctured, the lateral margins broadly sinuated, and the carinate edge sharply prominent; the anterior angles callous exteriorly, and destitute of the carinate edge. Humeral angles slightly recurved behind; median line pale. Propleura coarsely and confluently punctured, with a slender brown or red line each side continued interruptedly along the venter; meso- and meta-pleura punctate on the middle. Hemelytra almost white on the costal margin and inner edge; the surface pubescent, minutely

and closely punctate; the cuneus usually pale green, and the membrane hyaline, with rufous or pale-brown nervures, sometimes having a pale-brown streak protracted beyond the nervure. Scutellum more finely punctate than the pronotum, often having the punctures of the middle and base fuscous; the middle line pale and smooth. Tergum green or pale rufous, with the disk more or less infuscated. Venter green or testaceous, invested with close-set sericeous pubescence. Legs pale green, usually having the tarsi and tip of the tibiæ rufous; posterior femora usually having two series of piceous dots above and two similar series beneath; the nails and adjacent joint piceous.

Length, 6 to $7\frac{1}{2}$ millimeters. Breadth of pronotum, $1\frac{3}{4}$ to 2 millimeters.

Collected on the hills of Colorado in July (Lieutenant Carpenter). It is very common on low meadows in many parts of the Atlantic region.

Although this insect was referred to *Miris dorsalis*, Say, by Dr. Harris, it does not sufficiently agree with the description of that species to enable us to accept the determination. *M. dorsalis*, Say, still remains undetected by modern entomologists.

PHYTOCORIS, Fallen.

1. *P. nubilus*.

Capsus nubilus, Say, Heteropt. New Harmony, 22, No. 10.

Inhabits Texas; Mexico, near Matamoras, in the collection of Dr. Berlandier; Canada; New England; New York; Pennsylvania; New Jersey, in August; Maryland, on *Eupatorium*, in July and August; Georgia, and North Carolina.

2. *P. scrupeus*.

Capsus scrupeus, Say, Heteropt. New Harmony, 23, No. 13.
Capsus tetrastigma, H.-Schf., Wanz. Ins. ix, 166, fig. 959.
Capsus externus, H.-Schf., Wanz. Ins. viii, 16, fig. 791.

Inhabits Texas, Indian Territory, Mexico, Nebraska, Illinois, New England, Maryland, New Jersey, and Georgia.

This is a very variable insect, both in colors and in the width and thickness of the body and members. Pigmy specimens often occur in Eastern Massachusetts. I have found it in July on the grape-vines north of Baltimore.

The two figures of Herrich-Schaeffer represent varieties which are occasionally found in Maryland. Neither of them represents accurately the shape of the joints of the antennæ, although figure 791 is more nearly correct than the other.

LOPIDEA, Uhler.

L. media.

Capsus medius, Say, Heteropt. New Harmony, 22, No. 11.

Found on the foot-hills and plains of Colorado, September 19 and October 4, by Lieutenant Carpenter.

HADRONEMA, Uhler.

H. militaris.

Hadronema militaris, Uhler, Hayden's Survey of Montana, 412.

Collected July to September on the hills of Colorado.

LYGUS, Hahn.

1. *L. lineolaris.*

Capsus lineolaris, Palisot-Beauvois Ins. Afr. et Amér. 187, pl. xi, fig. 7.

Distributed over all the district traversed by the survey, as well upon the high mountains as on the hills and in the valleys.

It varies in the length and thickness of the antennæ and in the length of rostrum and hemelytra.

Specimens were collected above the timber-line in Colorado by Lieutenant Carpenter; and it occurs on the bald summits of the highest mountains in North Carolina.

2. *L. annexus.*

Lygus annexus, Uhler, in Hayden's Survey of Montana, 413.

Inhabits Colorado on the foot-hills (Lieutenant Carpenter).

CALOCORIS, Fieb.

1. *C. rapidus.*

Capsus rapidus, Say, Heteropt. New Harmony, 20, No. 4.
Capsus multicolor, H.-Schf., Wanz. Ins. viii, 19, fig. 795.

Inhabits Colorado, Arizona, Texas, and California.

2. *C. Palmeri.*

Calocoris Palmeri, Uhler, in Hayden's Survey of Montana, 410.

Inhabits Arizona and Southern Colorado.

RESTHENIA, Amyot & Serv.

1. *R. insignis.*

Capsus insignis, Say, Heteropt. New Harmony, 22, No. 12.

Inhabits Colorado and the Atlantic region.

2. *R. confraterna.*

Resthenia confraterna, Uhler, in Hayden's Survey of Montana, 411.

Inhabits Colorado, Wisconsin, Illinois, Maryland, &c.

DACOTA, Uhler.

D. hesperia.

Dacota hesperia, Uhler, in Hayden's Survey of Montana, 413.

Inhabits Colorado and Dakota.

PŒCILOSCYTUS, Fieb.

1. *P. venaticus.*

Pœciloscytus venaticus, Uhler, in Hayden's Survey of Montana, 414.

Inhabits Colorado, Illinois, New England, and Canada.

2. *P. diffusus.*

Pœciloscytus diffusus, Uhler, in Hayden's Survey of Montana, 415.

Inhabits Utah and Idaho.

Rhopalotomus, Fieb.

1. *R. pacificus.*

Rhopalotomus pacificus, Uhler, in Hayden's Survey of Montana, 415.

Inhabits Montana, Idaho, and California.

2. *R. brachycerus.*

Rhopalotomus brachycerus, Uhler, in Hayden's Survey of Montana, 416.

Inhabits California and Colorado.

Labops, Burm.

L. hesperius.

Labops hesperius, Uhler, in Hayden's Survey of Montana, 416.

Inhabits Colorado, Montana, and British America.

It varies somewhat in the breadth of the head and in the amount of yellow marking of the head, &c. Collected by Lieutenant Carpenter, in July and September, on the mountains and foot-hills.

Camptobrochis, Fieb.

C. nebulosus.

Camptobrochis nebulosus, Uhler, in Hayden's Survey of Montana, 417.

Inhabits Dakota, Colorado, Kansas, Missouri, Illinois, New England, and Maryland.

In the city of Baltimore, it is sometimes common in the crevices of the bark of linden trees; and in Massachusetts, it preys upon the females, and perhaps also upon the eggs, of the canker-moth.

Tinicephalus, Fieb.

T. simplex.

Tinicephalus simplex, Uhler, in Hayden's Survey of Montana, 417.

Inhabits Colorado, in July, on the foot-hills. Collected by Lieutenant Carpenter.

Plagiognathus, Fieb.

P. obscurus.

Plagiognathus obscurus, Uhler, in Hayden's Survey of Montana, 418.

Inhabits Texas, Colorado, and the Atlantic States.

Agalliastes, Fieb.

A. associatus.

Agalliastes associatus, Uhler, in Hayden's Survey of Montana, 419.

Inhabits Colorado and Utah.

Orectoderus. New gen.

Elongate, narrow; hemelytra contracted before the middle. Head long, obliquely declining and curving anteriorly, ♂; shorter and with the front almost vertical, ♀; behind the eyes narrowed into a neck, ♂; protracted, but scarcely narrowed, ♀; face from the eyes to tip forming a long, acute triangle, ♂, but shorter in the ♀; the surface between the eyes very broad and somewhat flattened, ♂. Eyes prominent, long, oval, placed obliquely; inferior cheek lobes ridged and tapering to a slender point, bounded above by a long deep groove, which carries the linear, carinate, superior cheek-lobe; jugum forming a slender, tapering, prominent ridge, separated from the tylus by a long groove; the tylus long

and slender. Rostrum long and slender, reaching to the intermediate coxæ; the basal joint somewhat more than one-half as long as the under side of head; second joint much longer, reaching to the tip of anterior coxæ; third and fourth subequal, each a little shorter than the second. Antennæ long and slender, nearly as long as the hemelytra; the basal joint about as long as the width of head between the eyes, ♂; or somewhat longer, ♀; second joint as long as the inner margin of the clavus, gradually thickening from beyond the middle to the tip; third much more slender, longer than the basal joint; the fourth shortest. Pronotum very long trapeziform, ♂; or long subcampanulate, ♀; in the latter separated into two divisions by a transverse constriction behind the middle, leaving the posterior lobe high and suborbicular. Scutellum almost equilateral, humped at base, the apex very acute. Hemelytra widest behind the middle, the cuneus long and narrow. Abdomen much contracted at base. Legs long and slender.

All the specimens thus far observed, of both sexes, have had fully-developed hemelytra and wings.

O. obliquus. New sp.

Long and slender, resembling *Systellonotus*, black or blue-black, polished. Face and cranium transversely obsoletely rugulose, indented on the vertex, and longitudinally impressed next the inner line of the eyes. Antennæ yellow or pale piceous, the apical half blackish-piceous; the third joint, excepting the base, and the fourth fuscous; eyes brown; rostrum piceous, paler on the middle, sometimes yellow, with a piceous tip. Pronotum minutely rugulose, densely so in the ♀, in which latter the surface is often dull opaque-black. Legs orange or pale piceous, the posterior pair usually darker; the coxæ pale or white, but darker or black on the anterior and intermediate ones in the ♀, while the posterior are conspicuously white; tarsi piceous at tip. Scutellum pale yellow or white on the apical division, ♀; or black, ♂. Hemelytra black, obsoletely punctured, remotely pubescent; the base of the corium having white streak running along parallel with the margin of the clavus; base of cuneus with a large white spot, ♂. The female lacks the white streak of the corium. Membrane piceous or smoke-black; wings a little infuscated. Venter black, polished, sometimes with a central row of rufo-piceous dots. Genital process of the male projecting laterally, long and wide, falcate.

Length, 6 to 7½ millimeters. Width across pronotum, 1 to 1½ millimeters.

A variety of the male lacks the white marks of the hemelytra, and at the same time has deep-orange legs. Immature specimens are chestnut-brown, with the white markings less distinct.

One male was obtained on the hills of Colorado, June to September, by Lieutenant Carpenter.

I have examined both sexes, from Massachusetts, Connecticut, Pennsylvania, Lower Canada, Illinois, Kansas, and Washington Territory.

Family ANTHOCORIDÆ.

Triphleps, Fieb.

T. insidiosus.

Reduvius insidiosus, Say, Heteropt. New Harmony, 32, No. 5.
Anthocoris pseudochinche, Fitch, Second Report on Nox. Ins. of New York, 295.

Inhabits Texas, Nebraska, Kansas, Illinois, Missouri, the Atlantic region, and Cuba.

Anthocoris, Fallen.

A. musculus.

Reduvius musculus, Say, Heteropt. New Harmony, 32, No. 6.

Collected above timber-line, in the mountains of Colorado, by Lieutenant Carpenter.

Family ARADIDÆ.

Aradus, Fab.

1. *A. acutus.*

Aradus acutus, Say, Heteropt. New Harmony, 28, No. 2.
Aradus americanus, H.-Schf., Wanz. Ins. viii, 115, fig. 889.

Found above timber-line, in the mountains of Colorado, by Lieutenant Carpenter. Common also in Florida, Indiana, &c.

This species is found under very contrasting climatal conditions. In the subalpine regions of the western Territories, it is liable to be suddenly caught by the frosts and severely cold winds of those exposed situations; while on the sea-coast of Florida, it exists in a climate loaded with moisture, of subtropical warmth and of perpetual mildness. In Southern Indiana, it is subject to the blasts of torrid heat, which rush over the plains from the farther South. But, in all these different conditions it retains a very steady uniformity of appearance, and does not exhibit much variation in the details of structure.

2. *A. tuberculifer.*

Aradus tuberculifer, Kirby, Fauna Bor.-Amer. iv, 278, pl. 6, fig. 5.

Inhabits Colorado, British America, California, &c.

Specimens were collected above timber-line in the first-named State. Mr. Kirby's came from the Hudson's Bay Territory.

The late Robert Kennicott obtained specimens in the vicinity of the Yukon River in Walrussia, and near the Great Bear Lake and Mackenzie River in British America.

3. *A. rectus.*

Aradus rectus, Say, Heteropt. New Harmony, 29, No. 4.

Inhabits Colorado, New Mexico, British America, New England, Georgia, North Carolina, and Florida.

4. *A. æqualis.*

Aradus æqualis, Say, Heteropt. 29, No. 6.

Inhabits Texas, Indian Territory, New Jersey, Illinois, &c.

5. *A. cinnamomeus.*

Aradus cinnamomeus, Panzer, Fauna German. 100, No. 20; Fieb. Europ. Hemipt. 111; H.-Schf., Wanz. Ins. v, 91, fig. 539.

Inhabits Texas, Missouri, and Southern Europe.

6. *A. ampliatus.* New sp.

Broad and thin; grayish-black; form similar to *A. crenatus*, Say. Head densely granulated; to the tip of the protuberance longer than the width across the eyes, the protuberance slightly tapering toward the tip; processes of the antenniferous tubercles slender, very acute, and not quite

as long as the basal joint of antennæ; antennæ black, stout, subcylindrical, the joints all of nearly equal thickness; first joint very short, the second very long, almost equal to the third and fourth united, the third orange on the apical half and longer than the fourth; surface in front of each eye raised into a blunt tooth; rostrum rust-brown, fuscous at tip. Pronotum transverse-subreniform, the anterior margin widest, arcuated, and broadly recurved each side, the margin irregularly and minutely toothed, the anterior angles a little acutely prominent; lateral obliquely narrowing posteriorly; posterior angles forming broad, rounded lobes, the posterior margin deeply sinuated; surface deeply depressed each side, irregularly and coarsely granulated, the disk with two longitudinal, approximate, raised lines, each side of which is a subinterrupted, less distinct, raised line. Scutellum coarsely and irregularly granulated, tumidly elevated on the disk, sunken behind the disk, and with the lateral margins very prominently elevated. Legs black; the coxæ, base of femora and a ring before their tip, the tip of tibiæ, and the tarsi ochreous yellow. Hemelytra deep black, more finely granulated, extending almost to the tip of the abdomen; base of corium exteriorly expanded into a wide, oval flap, which is broadly recurved, and the edge minutely serrated. Venter a little ferruginous; the central carina paler; the outer angles of the segments and a small part of the edges of the incisures of the connexivum both above and below ocher-yellow.

Length, 11 millimeters. Width of pronotum, 4 millimeters.

Inhabits California (James Behrens).

7. *A. debilis.* New sp.

Long, narrowing posteriorly, pale rust-brown; form similar to *A. acutus*, Say. Head long, longer than the width across the eyes, minutely and densely granulated; the protuberance entire, cylindrical, thick; cranium with a few coarse granules on the central ridge; processes of the antennal base short, acute; surface adjoining the eyes infuscated; before the eyes is a blunt, vertical process; antennæ very slender, the joints cylindrical, densely and evenly granulated, the second joint longer than the head, third and fourth joints a little stouter, the third whitish except at base, the fourth fuscous, a little shorter than the third, conical at tip; rostrum chestnut-brown, minutely, evenly granulated, reaching to the incisure between the meso- and meta-sternum. Pronotum wide sublunate, almost twice as wide as its length; the antero-lateral arcuated margin irregularly and remotely denticulated, broadly recurved, infuscated; posterior margin widely sinuated; behind the humeri produced into rounded flaps; disk infuscated, crossed by four longitudinal, anteriorly approximating, subentire, carinate lines; callosities very prominent, and bounded by sharply-defined lines. Scutellum infuscated, the basal angles tumidly elevated, the sides bounded from the base to beyond the middle by prominent, thick, carinate edges, the disk triangularly tumid, and sending backward a carinate longitudinal line. Legs irregularly granulated, faintly marbled with fuscous; the tips of tibiæ and a faint band on their middle yellow. Hemelytra clouded and marbled with fuscous; the base of the corium somewhat expanded into rounded, upturned lobes; membrane slightly net-veined, marbled, and clouded with fuscous. Venter almost uniform pale ferruginous; tergum a little darker; the connexivum faintly clouded with fuscous, and with a fuscous spot at the base of the segments adjoining the incisures. ♀

Length, 11 millimeters. Width of pronotum, $3\frac{1}{4}$ millimeters.

Inhabits Vancouver's Island.

A single female was kindly given to me by Mr. W. V. Andrews.

8. *A. inornatus.* New sp.

Dull fuscous; outline similar to *A. acutus*, Say. Differs from that species in being destitute of ochreous spots; the head and antennæ agree with it, except in the absence of the two rounded prominences of the cranium, which are in this replaced by linear protuberances; the postero-lateral margins of the pronotum narrowed obliquely posteriorly; the antero-lateral margins are arcuated, and armed with three or four large teeth, and with numerous irregular minute teeth. Rostrum barely reaching beyond the incisure between the pro- and meso-sternum.

Length, 9 to 10 millimeters. Width of pronotum, $2\frac{3}{4}$ to $3\frac{1}{2}$ millimeters.

Inhabits Nebraska, British Columbia, Wisconsin, Illinois, Pennsylvania; and in Maryland quite rare.

In one female, the incisures of the connexivum were a little cinereous, and the disks of the segments showed a faint cinereous spot.

9. *A. fuscomaculatus.*

Aradus fascomaculatus, Stål, Eugenies Resa, 260, No. 210.

Inhabits California, near San Francisco.

This species seems to be similar to *A. ornatus*, Say, Only a few fragments of what I believe to belong to it have thus far been available to me for examination, and I desire to call particular attention to it, that it may not continue to be overlooked by western entomologists.

At least five other species of the genus *Aradus*, from California, have been examined by me; but all the specimens were too imperfect for accurate description.

BRACHYRHYNCHUS, Lap.

1. *B. granulatus.*

Aradus granulatus, Say, Heteropt. New Harmony, 30, No. 7; Complete Writings, i, p. 353.
Dysodius parvulus, H.-Schf., Wanz. Ins. ix, 139, fig. 956.

Inhabits Texas, Cuba, Florida, Maryland, and Missouri.

2. *B. lobatus.*

Aradus lobatus, Say, Heteropt. New Harmony, 30, No. 8; Complete Writings, i, 354.

Inhabits Texas, Illinois, Michigan, Canada, Pennsylvania, and one specimen from Maryland.

3. *B. moestus.*

Mezira moesta, Stål, Hemipt. Mex. Stettin. Ent. Zeit. xxiii, 438.

Inhabits California, Arizona, and Mexico.

Perhaps this will prove to be the same as *B. americanus*, Spinola, from Chili. The differences between them are only such as occur in varieties of other species.

4. *B. simplex.* New sp.

Dark brunneous; minutely and densely granulated. Head a little widened at tip; the lateral lobes a little longer than the tylus; the lateral edges a little serrate-granulate, and longitudinally grooved; the tylus cylindrically raised above the plane of the cheeks, tinged with rufous; processes of the antennal base short, acute at tip, divaricating; antennæ short, robust, the third joint a very little longer than the sec-

ond, the rest subequal in length; under side of head coarsely granulated; rostrum ochreous-yellow. Pronotum trapezoidal; the lateral margins oblique, not distinctly emarginated; the anterior angles rounded, scarcely prominent; the posterior margin very feebly sinuated; the surface remotely and irregularly granulated. Pleural pieces and prosternum coarsely granulated; meso- and meta-sternum minutely rastrated and granulated. Femora roughly granulated, incrassated in the middle; tibiæ minutely granulated, coxæ, trochanters, base of femora, apex of tibiæ, and tarsi ocher-yellow. Base of membrane with a whitish cunous-mark, behind which is a brown spot. Venter granulated on the connexivum, minutely rastrated, and obsoletely granulated on the disk; superior edge of the connexivum tinged with rufous; genital segment of the male bluntly rounded. ♂ ♀.

Length $4\frac{1}{2}$ to $6\frac{1}{2}$ millimeters. Width of pronotum $1\frac{3}{4}$ to $2\frac{1}{4}$ millimeters.

Inhabits Texas, Indian Territory, Cuba, Missouri, Florida, New England, Pennsylvania, Illinois; and Maryland, beneath the bark of oak-trees, in February and March.

It differs from *B. granulatus*, Say, in not having the genital segment of the male long and obliquely rounded, but short and blunt, and in the third antennal joint being scarcely longer than the second, &c.

FAMILY PHYMATIDÆ.

PHYMATA, Lat.

P. erosa.

Cimex erosus, Linn., Syst. Nat. ed. 12, ii, 718, No. 19.
Cimex scorpio, De Geer, Mémoires, iii, 350, pl. 35, fig. 13.
Syrtis erosa, Fab., Syst. Rhyng. 121, No. 2.
Acanthia erosa, Wolff, Icon. Cim. 89, pl. 9, fig. 83.
Phymata erosa, Amyot et Serv., Hemipt. 290, No. 2.

Inhabits the greater part of North America, including the West Indies, Mexico, and Nicaragua. It seems to be not less common on the Pacific coast than in the Atlantic region.

In Maryland, it is very useful in destroying caterpillars and other vegetable-feeding insects; but is not very discriminating in its tastes, and would as soon seize the useful honey-bee as the pernicious saw-fly. It lurks about in the thick foliage of the gardens, and, concealed in the axil of a leaf or stem, it grasps suddenly with its fore claws the insect which may get near it, and then, thrusting the stout beak into the body of its victim, proceeds leisurely to withdraw its life-juices.

MACROCEPHALUS, Swed.

1. *M. prehensilis.*

Syrtis prehensilis, Fab., Syst. Rhyng. 123, No. 8.
Macrocephalus prehensilis, Amyot et Serv., Hemipt. 293, No. 2.

Inhabits Texas, Indian Territory, Mexico, and the Southern States generally. Its most northern limit at present known is the State of Tennessee.

2. *M. cimicoides.*

Macrocephalus cimicoides, Swederus, Nova Acta Holm. 1787, 3, tab. 8, fig. 1.
Syrtis manicatus, Fab., Syst. Rhyng. 123, No. 7; Burm., Handb. ii, 252; Wolff, Icon. Cim. 167, fig. 163; H.-Schf., Wanz. Ins. viii, 107, fig. 878.

Inhabits Texas and the Southern States; but will no doubt be found in Arizona, New Mexico, &c.

Family NABIDÆ.

Pagasa, Stål.

P. pallipes.

Pagasa pallipes, Stål, Enumeratio Hemipt. iii, 108, No. 3.

Inhabits Texas. Kansas, &c.

As this species has been commonly found in company with *Coriscus subcoleoptratus*, we may expect to find it in Colorado and Dakota.

Metatropiphorus, Reuter.

M. Belfragei.

Metatropiphorus Belfragei, Reuter, Öfvers. Vetens. Akad. Forhandl. 1872, 94, No. 1; Stål, Enumeratio Hemipt. iii, 111.

Inhabits Texas and the Southern States.

Coriscus, Schrank (1801).

(*Nabis*, Lat. 1807).

1. *C. subcoleoptratus.*

Nabicula subcoleoptrata, Kirby, Fauna Bor.-Amer. iv, 282.
Nabis subcoleoptratus, Reuter, Öfvers. Veterus. Akad. Forhandl. 1872, 81, No. 1.
Coriscus subcoleoptratus, Stål, Enumeratio Hemipt. iii, 112, No. 1.
Nabis canadensis, Provancher, Canad. Nat. 1869.

Inhabits Colorado, Dakota, Kansas, Nebraska, Canada, New England, Texas, &c.

2. *C. crassipes.*

Nabis crassipes, Reuter, l. c. 29, 6, p. 83, No. 5.

Inhabits Mexico, Texas, &c.

3. *C. sericans.*

Nabis sericans, Reuter, l. c. 29, 6, p. 83, No. 6.

Inhabits Texas.

4. *C. inscriptus.*

Reduviolus inscriptus, Kirby, Fauna Bor.-Amer. iv, 280, 1, pl. 6, fig. 7.

Inhabits British America, Maine, and Dakota.

5. *C. ferus.*

Cimex ferus, Linn., Fauna Suecicæ, 256, No. 962.
Nabis ferus, Fieb., Europ. Hemipt. 161, No. 9.

Inhabits California, Nebraska, Colorado, New England, the Atlantic region generally, including Maryland and Western North Carolina. In Europe, it occurs throughout most of the northern and central countries, and is not unknown in France, Italy, &c.

6. *C. Kalmii.*

Nabis Kalmii, Reuter, l. c. 29, 6, p. 91, No. 24.

Inhabits Wisconsin, Nebraska, &c.

7. *C. punctipes.*

Nabis punctipes, Reuter, l. c. 29, 6, p. 89, No. 20.

Inhabits Wisconsin, Nebraska, New Jersey, &c.

8. *C. nigriventris.*

Nabis nigriventris, Stål, Settin. Ent. Zeit. xiii, 458.

Inhabits Mexico and Texas.

SUPERFAMILY REDUVIOIDEA.

Rostrum free, curved, thick, and short. Antennæ many-jointed, 4–13, long and geniculate. Fore tibiæ expanded at tip. Hemelytra thin, with very large and long areoles; the membrane very large, and continued on the inner side of the corium.

SUBFAMILY REDUVIINA.

SINEA, Amyot et Serv.

1. *S. diadema.*

Reduvius diadema, Fab., Genera Ins. 302; Ent. Syst. iv, 206, No. 46.
Cimex multispinosus, De Geer, Mém. iii, 348, No. 23, pl. 35, fig. 11.
Cimex hispidus, Thunb., Nov. Ins. Spec. ii, 33,
Cimex setosus, Gmelin, Syst. Nat. i, pt. 4, 2144, No. 250.
Cimex diadema, Gmelin, Syst. Nat. i, pt. 4, 2196, No. 550.
Zelus diadema, Fab., Syst. Rhyng. 286, No. 18.
Reduvius raptatorius, Say, Amer. Ent. ii, pl. 31; Complete Writings, i, 72, pl. 31; Journ. Acad. Phila. iv, 327, No. 1.
Sinea multispinosa, Amyot et Serv., Hemipt. 375, No. 1.
Irantha hispida, Stål, Öfv. Vetensk. Akad. Forhandl. 1866, 264, No. 3.

Inhabits Texas, Nebraska, Colorado, Mexica, Indian Territory, and from Canada to Florida in the Atlantic region.

2. *S. coronata.*

Sinea coronata, Stål, Stettin. Ent. Zeit. xxiii, 444, No. 283.

Inhabits Mexico and California.

3. *S. raptoria.*

Sinea raptoria, Stål, l. c. xxiii, 444, No. 285.

Inhabits Texas, Mexico, and California.

ACHOLLA, Stål.

1. *A. multispinosa.*

Cimex muiltispinosus, De Geer, Mém. iii, 348, p. 23, pl. 35, fig. 10.
Reduvius sexspinosus, Wolff, Icones Cimicum, iii, 124, No. 118, fig. 118.
Harpactor subarmatus, H.-Schf., Wanz. Ins. viii, 83, fig. 852.
Acholla sexspinosa, Stål. Settin. Ent. Zeit. xxiii, 445 (note).

Inhabits Nebraska, Wisconsin, Illinois, New England, New York, &c.

2. *A. tabida.*

Ascra tabida, Stål, Settin. Ent. Zeit. xxiii, 446, No. 287.
Acholla tabida, Stål, Enumeratio Hemipt. ii, 72, No. 3.

Inhabits Mexico and California.

PRIONOTUS, Lap.

P. cristatus.

Cimex cristatus, Linn., Cent. Ins. Rar. 16, No. 42; Amœn. Acad. vi, 399, No. 42; Syst. Nat. ed. 12 (1767), i, pt. 2, 723, No. 62.
Reduvius novenarius, Say, Amer. Ent. i, pl. 31, No. 2; Complete Writings, i, 71, pl. 31; Heteropt. New Harmony, 33, (reference under *Nabis*).
Arilus denticulatus, Westw., in Drury's Illustr. new ed. ii 73.

Inhabits Southern States, Texas, Indian Territory, and Atlantic region south of New York.

One specimen from Mexico, not differing essentially from the common type. In Maryland, it dwells upon the small pine-trees, and makes havoc with the caterpillars and other insects which come within its reach.

ATRACHELUS, Amyot et Serv.

A. cinereus.

Reduvius cinereus, Fab., Ent. Syst. suppl. 545, 48–49.
Zelus cinereus, Fab., Syst. Rhyng. 287, No. 24.
Atrachelus heterogeneus, Amyot et Serv., Hémipt. 374, 1, pl. 7, fig. 4.

Inhabits the Southern States, Texas, and Mexico.

FITCHIA, Stål.

1. *F. nigro-vittata.*

Fitchia aptera, Stål, Öfvers. Vetensk. Akad. Forhandl. 1859, 371, No. 1.
Fitchia nigro-vittata, Stål, Öfvers. Vetensk. Akad. Forhandl. 1866, 296, No. 1.

Inhabits Texas, Kansas, Indian Territory, and Colorado.

2. *F. spinosula.*

Fitchia spinosula, Stål, Enumeratio Hemipt. ii, 79, No. 2.

Inhabits Texas, Colorado, &c.

REPIPTA, Stål.

R. taurus.

Zelus taurus, Fab., Syst. Rhyng. 291, No. 39.
Zelus lineatus, Amyot et Serv., Hémipt. 373, No. 2.
Repipta taurus, Stål, Stettin. Ent. Zeit. xxiii, 446, No. 291.

Inhabits Texas, Mexico, Florida, &c.

ZELUS, Fab.

1. *Z. bilobus.*

Zelus bilobus, Say, New Sp. Ins. of Louisiana, 12; Complete Writings, i, 306.

Inhabits Louisiana, Texas, and Mexico.

2. *Z. cervicalis.*

Zelus cervicalis, Stål, Enumeratio Hemipt. ii, 90, No. 15.

Inhabits Texas, California, Mexico, and Florida.

DIPLODUS, Stål.

1. *D. luridus.*

Diplodus luridus, Stål, Stettin. Ent. Zeit. xxiii, 452 (foot-note).

Inhabits the Atlantic region, and extends westward into Texas and Colorado.

2. *D. Renardii.*

Zelus Renardii, Kolenati, Meletemata Entom. 1857, vi, 42, tab. 3, fig. 2.
Diplodus Renardii, Stål, Enumeratio Hemipt. ii, 91, No. 36.

Inhabits California.

PINDUS, Stål.

P. socius.

Pindus socius, Uhler, in Hayden's Survey of Montana, 420.

Inhabits near Snake River, Idaho, and Dakota, Kansas, and Arizona.

MILYAS, Stål.

1. *M. cinctus.*

Reduvius cinctus, Fab., Gen. Ins., 302, Nos. 5–6; Ent. Syst. iv, 199, Nos. 20.
Cimex præcinctus, Gmelin, Syst. Nat. i, pt. 4, 2198, No. 565.
Harpactor cinctus, H.-Schf., Wanz. Ins. viii, 83, fig. 853.
Milyas cinctus, Stål, Hemipt. Fabriciana, i, 106, No. 1.

Inhabits the Atlantic region from Massachusetts to Georgia, and westward into Texas and the Indian Territory. One specimen from Cheyenne.

2. *M. zebra.*

Milyas zebra, Stål, Stettin. Ent. Zeit. xxiii, 448, No. 299.

Inhabits California, Lower California, and Mexico. Closely related to the preceding species, but differing from it in being darker-colored, more hairy, and with four whitish rings on the first joint of the antennæ.

SUBFAMILY APIOMERINA.

APIOMERUS, Hahn.

1. *A. spissipes.*

Reduvius spissipes, Say, Journ. Acad. Phila. iv, 199, No. 20; Amer. Ent. ii, pl. 31, fig. 3.
Apiomerus spissipes, Stål, Enumeratio Hemipt. ii, 98, No. 15.

Inhabits Texas, Colorado, Mexico, and Arizona.

2. *A. crassipes.*

Reduvius crassipes, Fab., Syst. Rhyng. 273, No. 35; Say, Amer. Ent. ii, pl. 31, fig. 4.
Reduvius linitaris, Say, Heteropt. New Harmony, 31, No. 1.
Herega rubrolimbata, Amyot et Serv., Hémipt. 354, No. 1.
Apiomerus crassipes, Stål, Hemipt. Fabr. i, 117, No. 3.

Inhabits Texas, Kansas, Nebraska, the Atlantic region, and Canada.

3. *A. flaviventris.*

Apiomerus flaviventris, H.-Schf., Wanz. Ins. viii, 77, fig. 847.
Apiomerus flaviventris, Stål, Enumeratio Hemipt, ii, 98, No. 16.

Inhabits Arizona, California, New Mexico, Texas.

4. *A. ventralis.*

Reduvius ventralis, Say, Heteropt. New Harmony, 31, No. 2.

Inhabits Missouri, Nebraska, region of the Saskatchewan River. Collected by Robert Kennicott.

5. *A. repletus.* New sp.

Form of *A. hirtipes*, Hahn. Black, robust, densely invested with brownish-black, erect pubescence. Head and surface of the pronotum polished; eyes brown; antennæ brownish-piceous, excepting the basal joint, which is deep black. Lateral margins and humeral angles of the pronotum densely beset with stiff bristles; the anterior lobe longitudinally, deeply, and widely scooped out, each side with high oblique ridges, defined by deep furrows. Hemelytra velvety; the dense pile short, black. On the disk of each corium is a crimson-red, large, triangular spot. Abdomen with dense, erect, moderately short pile; the connexivum, both above and below, almost bald, polished, only the base pubescent, the incisures pale yellow; anal lobes large, lamellate, circular, pale yellow, the margin thickened.

Length, 21 millimeters. Width of pronotum, 7 millimeters.

Inhabits California.

Subfamily HAMMATOCERINA.

Hammatocerus, Burm.

1. *H. purcis.*

Cimex purcis, Drury, Illustr. iii, 63, tab. 45, fig. 4.
Hammatocerus nycthemerus, Burm., Handb. ii, pt. 1, 236, No. 1.
Hammatocerus furcis, Blanch., Hist. des Ins. iii, 105, No. 1; Amyot et Serv., Hémipt, 346, No. 1.

Inhabits Virginia and the region south and southwest, through Texas, into Mexico, and Indian Territory. This species varies much in the extent of the red color of the femora; and no doubt the *H. luctuosus*, Stål, of Mexico, will yet prove to be only a variety of it. Dr. Edward Palmer collected one specimen in the vicinity of the old Fort Cobb.

Subfamily ECTRICHODIINA.

Ectrichodia, St. Farg. & Serv.

1. *E. cruciata.*

Petalocheirus cruciatus, Say, Heteropt. New Harmony, 33, No. 1; Complete Writings, i, 358, 1.
Ectrichodia cruciata, Stål, Enumeratio Hemipt. ii, 103, No. 4.
Ectrychotes bicolor, H.-Schf., Wanz. Ins. viii, 53, fig. 822.
Rhiginia crudelis, Stål, Stettin. Ent. Zeit. xxiii, 455, No. 319.

Inhabits Pennsylvania, Maryland, and the region south and west into Texas, Mexico, and New Mexico.

2. *E. cinctiventris.*

Ectrichodia cinctiventris, Stål, Enumeratio Hemipt. ii, 103, No. 5.

Inhabits Texas, New Mexico, and Mexico.

It is the largest species thus far detected in the United States; but it varies extraordinarily in size and somewhat also in color.

Dr. Lincecum met with it in Washington County, Texas, and I have received it from several other parts of this State.

Subfamily PIRATINA.

Sirthenea, Spin.

S. carinata.

Reduvius carinatus, Fab., Ent. Syst. suppl. 545, Nos. 36–37; Coquebert, Illust. i, 42, pl. 10, fig. 15.
Peirates carinatus, Serv., Ann. Sci. Nat. xxiii, 221, No. 10.
Rasahus carinatus, Amyot et Serv., Hist. Hémipt. 326, No. 1.
Sirthenea carinata, Stål, Hem. Fabr. i, 120, No. 2.

Inhabits California, Mexico, Texas, and the Southern States.

Rasahus, Amyot & Serv.

1. *R. biguttatus.*

Petalochirus biguttatus, Say, Ins. of Louisiana, 13; Heteropt. New Harmony, 33, No. 2.
Pirates mutillarius, Guer., in Sagra's Hist. de Cuba, 410 (excluding the synonymy).

Inhabits Arizona, California, Mexico, Louisiana, Texas, Panama, Para, Cuba, and West Virginia.

This insect affords an excellent example of the changes which a species undergoes in being adjusted to the conditions which prevail in each comparatively small region of its habitat. There are small differences in the specimens from each locality, which enable us to link together the forms from these widely remote places. In general, the form from Cuba contrasts strongly with that from California both in color and structure.

At Para, it acquires more distinctly the blackish obscuration of the apical part of the femora; but there is a tendency to this observable in some of the specimens from near San Francisco. This same blackening of the femora is also seen in specimens of *Sirthenea carinata* from the basin of the Amazonas.

An intimate acquaintance with these and similar insects will, no doubt, add much to our knowledge of the origin and structure of the regions which they affect, and may give a clew to the place of their origin, and determine the reasons of their present distribution. A pressing need of the present time is a systematic and accurate survey of our still wild territories, including the proper preservation of large series of specimens from every kind of locality. This would clear away many of the difficulties which now obstruct the study of the present life-areas of the great West, and settle upon a secure basis our knowledge of the dependence of organisms upon the structure of the country they inhabit, and the extent and nature of their reactions upon the productions of that country.

Melanolestes, Stål.

1. *M. picipes.*

Pirates picipes, H.-Schf., Wanz. Ins. viii, 62, fig. 831.
Melanolestes picipes, Stål, Enumeratio Hemipt. ii, 107, No. 3
Reduvius pungens, LeConte, Proc. Acad. Phila. 1855, 404.

Inhabits California, Texas, Indian Territory, and the Atlantic region from Maine to Florida and Louisiana, and Para, Brazil.

2. *M. abdominalis.*

Pirates abdominalis, H.-Schf., Wanz. Ins. viii, 63, fig. 832.

Inhabits California, Mexico, and the Atlantic region; also, from old Fort Cobb, Indian Territory, by Dr. E. Palmer.

The evidence at present in my possession does not warrant the uniting of these two species. Both are quite common in Maryland, sometimes occurring under the same stone; but while I have seen the sexes united, I have never seen a male of the one caress or unite with a female of the other. The width and proportions of the head and pronotum and abdomen vary considerably in the specimens of both of these species, so that, in the absence of a long series of them, they might be made to constitute a number of species.

Subfamily ACANTHASPIDINA.

Meccus, Stål.

M. phyllosomus.

Conorhinus phyllosomus, Burm., Handb. ii, 1, 246, No. 3.
Meccus phyllosoma, Stål, Berlin. Ent. Zeit. iii, 105.

Inhabits California and Mexico.

A single specimen from near San Diego is deep black, highly polished on the surface of pronotum, and the only red present is upon the outer edge of the abdomen.

Conorhinus, Lap.

1. *C. rubrofasciatus.*

Cimex rubrofasciatus, De Geer, Mém. iii, 349, pl. 35, fig. 12.
Reduvius gigas, Fab., Syst. Ent. 729, No. 1.
Cimex erythrozonias, Gmelin, Syst. Nat. i, pt. 4, 2181, No. 456.
Cimex gigas, Gmelin, *ib.* 2195, No. 544.
Conorhinus gigas, Burm., Handb. ii, pt. 1, 246, No. 1; Blanchard, Hist. des Insectes, iii, 108, No. 2.
Conorhinus rubrofasciatus, Amyot et Serv., Hémipt. 384, No. 1, pl. 8, fig. 2.
Conorhinus gigas, H.-Schf., Wanz. Ins. viii, 72, figs. 841, 842.
Conorhinus Stålii, Signoret, Ann. Soc. Ent. France, 3d ser., viii, 967, No. 184.
Conorhinus rubrofasciatus, Stål, Berlin. Ent. Zeit. iii, 106, No. 1.

Inhabits California, Texas, Kansas, Mexico, Brazil, Asia, and Africa.

The specimens from California and Mexico have the anterior angles of the pronotum less produced than in the African and South American. Occasionally a specimen obtained in California is almost uniformly deep or rusty black. Whether this is a feature of all the specimens from a particular locality, or only a peculiarity of sporadic examples, has not yet been determined.

2. *C. variegatus.*

Cimex variegatus, Drury, Illust. i, 109, pl. 45, fig. 5.
Cimex claviger, Gmelin, Syst. Nat. i, pt. 4, 2179, No. 441.
Conorhinus lecticularius, Stål, Berlin. Ent. Zeit. iii, 107, No. 2; Hemipt. Fabr. i, 124, No. 3.

Inhabits Texas, Indian Territory (Dr. Palmer), California, Georgia, Louisiana, and Illinois.

3. *C. sanguisugus.*

Conorhinus sanguisuga, LeConte, Proc. Acad. Phila. vii, 404.
Conorhinus lateralis, Stål, Berlin. Ent. Zeit. iii, 107, No. 3.

Inhabits Virginia, Maryland, Ohio, Texas, Florida, Illinois, and Panama.

The extended geographical range of this blood-thirsty tenant of the beds in houses is noteworthy, and no doubt it has, like its congener, *C. gigas*, been aided in its range by human agency.

4. *C. Gerstæckeri.*

Conorhinus Gerstæckeri, Stål, Berlin. Ent. Zeit. iii, 111, No. 9; Hemipt. Fabr., i, 124, No. 8.

Inhabits Texas.

Family STENOPODIDÆ.

Centromelus, Fieb.

C. languidus.

Pnirontis languida, Stål, Öfvers. Vetensk. Akad. Forhandl. 1859, 382, No. 2.
Centromelus languida, Stål, Enumeratio Hemipt. ii, 120, No. 1.

Inhabits Texas, Florida, South Carolina, and Brazil.

PYGOLAMPIS, Germ.

1. *P. pectoralis.*

Reduvius pectoralis, Say, Ins. of Louisiana, 11; Complete Writings, i, 306.
Pygolampis fuscipennis, Stål, Öfvers. Akad. 1859, 379, No. 4.
Pygolampis pectoralis, Uhler, Proc. Boston Soc. Nat. Hist. 1871, 15.

Inhabits Texas, California, Louisiana, Maryland, Florida, Massachusetts, Cuba, and New York.

2. *P. sericea.*

Pygolampis sericea, Stål, Öfvers. Vetensk. Akad. Forhandl. 1859, 380, No. 5.

Inhabits Texas, Maryland, Pennsylvania, and South Carolina.

GNATHOBLEDA, Stål.

G. tumidula.

Gnathobleda tumidula, Stål, Enumeratio Hemipt. ii, 121, No. 3.

Inhabits Texas, Cuba, &c.

STENOPODA, Lap.

S. culiciformis.

Cimex culiciformis, Fab., Syst. Ent. 728, No. 162; Species Ins. ii, 376, No. 231.
Gerris culiciformis, Fab., Ent. Syst. iv, 189, No. 7.
Stenopoda cinerea, Lap., Ess. 26, pl. 52, fig. 2.
Stenopoda culiciformis, Stål, Hemipt. Fabr., i, 129, No. 1.

Inhabits Texas, Florida, Georgia, Alabama, Cuba, Mexico, Indian Territory, Panama, and Arkansas.

SPILALONIUS, Stål.

S. geniculatus.

Spilalonius geniculatus, Stål, Enumeratio Hemipt. ii, 123, 1.

Inhabits Texas.

NARVESUS, Stål.

N. carolinensis.

Narvesus carolinensis, Stål, Öfvers. Akad. Forhandl. 1859, 385, 1; Enumeratio Hemipt., 124.

Inhabits Texas, Missouri, South Carolina, and Cuba.

FAMILY EMESIDÆ.

EMESA, Fab.

E. longipes.

Cimex longipes, De Geer, Mém. iii, 352, No. 326, pl. 35, figs. 16, 17.
Ploiaria brevipennis, Say, Amer. Ent. iii, pl. 47; Complete Writings, i, 106.
Emesa filum, G. R. Gray, Griffith's Animal Kingdom, xv, 244, pl. 97, fig. 3.
Emesa pia, Amyot et Serv., Hémipt. 394, No. 2; H.-Schf., Wanz. Ins. ix, 114, fig. 937; Dohrn, Linnæa Ent. xiv, 231.
Emesa longipes, Dohrn, Linnæa Ent. xiv, 221, No. 4; Uhler, Proc. Boston Soc. Nat. Hist. 1871, 15.

Inhabits Texas, Pennsylvania, New York, Indiana, Illinois, and Connecticut.

This species has, within a few years, spread into the region adjoining Baltimore, living in the branches of small pine-trees and in out-houses and barns.

Professor Verrill kindly permitted me to examine a large series of specimens of both sexes belonging to the museum of Yale College, collected in that vicinity. There are small differences in the punctation and rugosities of the surface, and some in the width and distinctness of the white bands upon the legs. Older specimens are often suffused with red, a sort of ripening toward the autumn, which we have observed to be common in *Euschistus*, *Coreus*, *Euthoctha*, &c.

FAMILY SALDIDÆ.

SALDA, Fab.

1. *S. Signoretii.*

Salda Signoretii, Guer., in Sagra's Hist. de Cuba, 401, pl. 13, fig. 10.

Inhabits Cuba, Mexico, sea-coast of Texas, of Maryland, and of Massachusetts on the southern side of Cape Cod. It does not occur on the sea-shore north of Cape Ann, as far as I have been able to discover, although I made diligent search there and on and near Old Orchard Beach, on the coast of Maine. Its present meridional range is known to be from Cape Cod to the sand-beaches near Havana, in the island of Cuba. It is interesting to record that this pale-colored species inhabits the white, sandy spots near the beaches, while the *S. ligata* lives on the blackish gneiss bowlders of our streams, and the *S. interstitialis* and other black species select the black, sandy loam adjacent to water for their dwelling-places.

On Chelsea Beach, or, rather, on the marshes there, where there are spots of earth and soil of black, grayish-brown, and almost white, the colors of the *Saldæ* found at rest are mainly black, pale brown, or largely white, according generally with the color of the soil.

A form of *Salda* closely allied to *S. ligata* is found in great numbers on the black mud of the salt-marshes in Eastern Massachusetts, but while adhering to the general pattern of ornamentation of its group, the black color prevails and the white spots are reduced to a minimum. Also, in these places where the conditions of soil and surroundings are so uniform and persistent, there is scarcely any variation observable in the individuals of this species. An examination of many hundreds collected over a surface of a mile or more in extent yielded but very slight variations in the shape, size, or arrangement of their markings.

2. *S. interstitialis.*

Acanthia interstitialis, Say, Journ. Acad. Phila. iv, 324, No. 1.

Inhabits Texas, New Mexico, California, Colorado, Nebraska, Missouri, Canada, British Columbia, Illinois, Michigan, Maine to Florida, Cuba, and Hayti.

3. *S. lugubris.*

Acanthia lugubris, Say, Heteropt. New Harmony, 34, No. 3.

Inhabits New Mexico, Texas, Missouri, Wisconsin, Michigan, Illinois, Maine, Canada, Massachusetts, Rhode Island, British America near Bear Lake; Saskatchewan, New York, Pennsylvania. Maryland, in September, on a black, marshy spot, overgrown with cresses, near a stream of clear water.

4. *S. ligata.*

Acanthia ligata, Say, Heteropt. New Harmony, 34, No. 1.

Inhabits Nebraska, Minnesota, Illinois, Indiana; near Quebec, Abbé

Provancher; Maine, Andover, Cambridge, Waltham, in Massachusetts, F. G. Sanborn; Maryland, May 28 until September 20, P. R. Uhler; North Carolina, James B. Bean.

5. *S. humilis.*

Acanthia humilis, Say, Heteropt. New Harmony, 35, No. 4.

Inhabits Texas, Florida, Maryland (May and June), Pennsylvania, Massachusetts, Maine, Rhode Island, California, and Illinois.

6. *S. coriacea.*

Salda coriacea, Uhler, in Hayden's Survey of Montana, 421, No. 2.

Inhabits Utah, British America, Illinois, and New England.

7. *S. luctuosa.*

Salda luctuosa, Stål, Freg, Eugenies Resa, 263, No. 123.
Acanthia luctuosa, Stål, Enumeratio. Hemipt. iii, 149, No. 8.

Inhabits California.

8. *S. saltatoria.*

Cimex saltatorius, Linn., Fauna Suec. 964; Syst. Nat. (1767), 500, No. 93.
Salda saltatoria, Fab., Syst. Rhyng. 239 H. Schf., Wanz, Ins. ii, 83, fig. 167; Wolff, Icon. Cim. 77, tab. 8, fig. 74.

Inhabits Nebraska, Illinois, Northern New York, Maine, Canada, British Columbia, and Europe.

FAMILY VELIIDÆ.

MACROVELIA, Uhler.

M. Hornii.

Macrovelia Hornii, Uhler, in Hayden's Survey of Montana, 422.

Inhabits California, Arizona, and New Mexico.

VELIA, Latr.

V. armata.

Velia armata, Burm., Handb. ii, pt. 1, 212, No. 4.

Inhabits Texas and Mexico.

Only two specimens, females, have thus far been brought to my notice. They were collected near Waco by G. W. Belfrage.

RHAGOVELIA, Mayr.

R. collaris.

Velia collaris, Burm., Handb. ii, pt. 1, 212, No. 5.
Rhagovelia collaris, Mayr, Novara Reise, Hemipt. 180.
Velia Fieberi, Guer., in Sagra's Hist. de Cuba, Ins. 416.

Inhabits the Atlantic region, Florida, Texas, Mexico, Cuba, and Hayti.

Dr. Burmeister's types came from near Port au Prince. One hundred and fifty miles west of that place I found them quite abundant upon a quiet land-locked place in the Grand Anse River, where they were very abundant, and where they occurred both winged and unwinged.

Family HYGROMETRIDÆ.

Hygrotrechus, Stål.

1. *H. remigis.*

Gerris remigis, Say, Heteropt. New Harmony, 35, No. 1.

Inhabits Texas, Arizona, Colorado, and the Atlantic region.

Lieutenant Carpenter collected specimens in the mountains of Colorado in July.

2. *H. robustus.*

Hygrotrechus robustus, Uhler, in Packard's Insects Inhabiting Salt-Water, Silliman's Journal, 1871, i, 105.

Inhabits Clear Lake, California.

It is of much interest to know whether the pale colors of this and of the other *Hemiptera* of salt-lakes are caused by the presence of alkaline substances in the waters; or, have only immature specimens been met with by those who have collected there?

Limnoporus, Stål.

L. rufoscutellatus.

Limnoporus rufoscutellatus, Lat., Genera et Sp. Ins. iii, 134, 2.

Mountains of Colorado, July, Lieutenant Carpenter.

From the numerous specimens which I have examined, this species seems to be common in Colorado. In that region, it attains to full proportions, and puts on its clearest russet-brown coat. It is quite common on still waters in early summer in Eastern Massachusetts. But near Baltimore I have met with it only twice—in early spring, and then only in the most dwarfed specimens that I have ever seen. The wide distribution of these insects may be brought about by the agency of birds and reptiles. The cranes and wild ducks frequent occasionally the pools in the fresh-water marshes where these insects live, and on the eastern side of our continent it is within the limits of the range of these birds that this species has been found most frequently. Our toads and frogs cram themselves with insects of the water and marsh, and to the rough backs and flanks of these creatures the ova and young of our water-skimmers might readily adhere, and be transported to a considerable distance from their original habitat.

Family PELOGONIDÆ.

Pelogonus, Latr.

P. americanus. New sp.

Broadly oval, slaty-blackish, opaque, the pronotum a little narrower than the abdomen. Head polished, minutely punctured in part, invested with very sparse silvery prostrate pubescence, which is more dense beneath; rostrum reaching the end of the second ventral segment, blackish-piceous on the swelled base, the remainder pale rufo-testaceous; antennæ pale piceous; face obsoletely carinate, each side with a series of oblique wrinkles, its anterior and lateral boundaries carinated. Pronotum transverse, velvety blackish, with a few short wavy lines and some dots of bluish lead-color, and remotely golden pubescent; the lateral margins slightly oblique, only a little narrowing anteriorly, and rounding against the anterior angles, which are distinct and almost

acute; touching the margin a little way back, each side, is a small triangular yellow spot; posterior angles subrectangular; the posterior margin waved each side of the center, where it is also a little yellowish. Pectoral surface dull black, with very sparse sericeous scales exteriorly; the spots of the dorsal margin equally visible beneath; sternal margins piceous. Legs dull pale piceous-yellow. Hemelytra broad, widening posteriorly, velvety black, pubescent, sprinkled with golden pubescence, spotted and dotted with bluish lead-color; the costal margin yellow, and with five small yellow spots; membrane bluish lead-color, with the nervures black. Venter piceous black, densely, minutely sericeous pubescent, the edges of the segments and the tip of the last one a little reddish-ipceous. The connexivum is unspotted, and the surface of the tergum black, polished, with rufo-piceous edges to the segments.

Length, 5 millimeters. Width of pronotum, $2\frac{1}{2}$ millimeters. Width across the hemelytra, scantily 3 millimeters.

Inhabits Texas, Illinois, Eastern Massachusetts, Pennsylvania, and Cuba. A specimen from near Dedham, Mass., collected near water, in April, was sent to me by F. G. Sanborn; also, an immature one from near a spring, in York County, Pennsylvania, was kindly given to me by Dr. F. E. Melsheimer.

The species has thus far been detected in but a very few places, and only by the most scrutinizing collectors. It occurs near water in places which are overgrown with marsh-plants. It may be at once known from the European one by being wider posteriorly than in front, and by the absence of the quadrate yellow spots from the connexivum.

A specimen from Cuba, obtained by Professor Poey, has the spots of the costal margin of the hemelytra almost obsolete; but it agrees with the United States form in all other respects.

The pattern of marking on the costal margin of the hemelytra is in close imitation of that commonly seen upon the connexivum of various Pentatomids, Scutellerids, and Coreids. It can serve no purpose in protecting the creature from its enemies, and does not belong to one sex more than to the other. Characters of this kind are usually acquired at the time of changing the last nymph-skin to become an imago.

Family GALGULIDÆ.

Galgulus, Latr.

1. *G. oculatus.*

> *Naucoris oculata,* Fab., Syst. Rhyng. 111, No. 5.
> *Galgulus oculatus,* Latr., Hist. Nat. Ins. xii, 286, pl. 95, fig. 9; Fab., Ent. Syst. suppl. 525, Nos. 3–4.
> *Galgulus bufo,* H.-Schf., Wanz. Ins. v, 88, fig. 536.

Inhabits Texas, Arizona, Indian Territory, Missouri, Illinois, Michigan, and the Atlantic region generally. In New Jersey, and in some sections of Maryland, there are two broods annually, the one in May and the other in August.

Prof. Cyrus Thomas observed this species leaping to seize (as he supposed) *Xya terminalis*, in the State of Illinois.

2. *G. variegatus.*

> *Galgulus variegatus,* Guer., Iconog. Règne Animal, 352.
> *Galgulus pulcher,* Stål, Öfv. Vetensk. Akad. Förhandl. 1854, 239, No. 1.

Inhabits Southern Texas, Mexico, California, Florida, Cuba, Georgia, South Carolina, and Maryland. In the last-mentioned State, a single

specimen occasionally occurred in the flocks of these creatures which affected the marshy and damp margins of some of our streams; but recently they have failed to appear, and only the *G. oculatus* remains in smaller numbers.

MONONYX, Lap.

M. badius.

Mononyx badius, H.-Schf., Wanz. Ins. ix, 27, fig. 894.
Mononyx obscura, Stål, Öfv. Vetensk. Akad. Förhandl. 1854, 239, No. 3.

Inhabits San Diego, California, Mexico, Panama, &c.
It varies considerably in the depth and clearness of the brown color.

FAMILY NAUCORIDÆ.

NAUCORIS, Geoff.

N. Poeyi.

Naucoris Poeyi, Guer. (*nec* Amyot), Icones Règne Animal, 352, pl. 57, fig. 5; La Sagra's Hist. Île de Cuba, 175.

Inhabits Texas, Mexico, Cuba, Rio in Brazil, Illinois, Michigan, and the Atlantic region from Cape Cod to Southern Florida. *Ambrysus Poeyi* from Mexico is quite different from this.

AMBRYSUS, Stål.

1. *A. Signoreti.*

Ambrysus Signoreti, Stål, Hemipt. Mex. Stettiner Ent. Zeit. xxiii, 460, No. 336.
Naucoris Poeyi, Amyot et Serv., Hémipt. 434, pl. 8, fig. 5 (*nec* Guerin).

Inhabits California, Mexico, Arizona, and New Mexico.

2. *A. melanopterus.*

Ambrysus melanopterus, Stål, Hemipt. Mex. 460, No. 337.

Inhabits Mexico and Arizona.

FAMILY BELOSTOMIDÆ.

BELOSTOMA, auctor.

1. *B. americanum.*

Belostoma americanum, Leidy, Journ. Acad. Phila. new ser. i, 66.

Inhabits Texas, and the Atlantic region from Massachusetts to Florida.

2. *B. annulipes.*

Belostoma annulipes, H.-Schf., Wanz. Ins. viii, 28, figs. 803, 804.

Inhabits Western United States, Mexico, Central America and Northern South America, Texas, and occurs more rarely in the Atlantic region.

BENACUS, Stål.

B. griseus.

Belostoma grisea, Say, Heteropt. New Harmony, 37, No. 2.
Belostoma haldemanum, Leidy, Journ. Acad. Phila. new ser. i. 66 (plate).
Benacus haldemanus, Stål, Öfv. Vetensk. Akad. Förhandl. 1861, 205.
Belostoma angustatum, Guer., La Sagra's Hist. de Cuba, 420.

Inhabits Texas, Cuba, and the Eastern United States from Massachusetts to Florida inclusive.

Zaitha, Amyot & Serv.

1. *Z. fluminea.*

Belostoma fluminea, Say, Heteropt. New Harmony, 37, No. 1.
Perthostoma aurantiacum, Leidy, Journ. Acad. Phila. new ser. i, 60.

Inhabits almost all the region east of the great plains, Texas, and Louisiana.

2. *Z. fusciventris.*

Zaitha fusciventris, Dufour, Ann. Soc. Ent. France, 4th ser. iii, 389, No. 11.

Inhabits Arizona, California, and Mexico.

Serphus, Stål.

1. *S. dilatatus.*

Belostoma dilatata, Say, Heteropt. New Harmony, p. 38, No. 3, 3.
Serphus dilatatus, Stål, Hemipt. Mex. Stettiner Ent. Zeit. xxiii, 462.
Zaitha Stollii, H.-Schf., Wanz. Ins. ix, 35, fig. 898.

Inhabits California, Arizona, and Mexico.

Pedinocoris, Mayr.

1. *P. brachonyx.*

Pedinocoris brachonyx, Mayr, Verhandl. Wien. zool.-botan. Gesells. 1863, 351, tab. 11, fig. 5.
Zaitha indentata, Hald., Proc. Acad. Phila. vi. p. 364.

Inhabits California.

2. *P. macronyx.*

Pedinocoris macronyx, Mayr, Verhandl. Wien. zool.-botan. Gesells. 1863, 350, tab. 11, figs. 1–4.

Inhabits California.

Abedus, Stål.

A. ovatus.

Abedus ovatus, Stål, Stettiner Ent. Zeit. xxiii, 461.
Stenoscytus mexicanus, Mayr, Verhandl. Wien. zool.-botan. Gesells. 1863, 347, tab. xi., figs. 6–10.

Inhabits Arizona, Texas, Mexico, and Central America.

Family NEPIDÆ.

Ranatra, Fab.

1. *R. fusca.*

Ranatra fusca, Beauv., Ins. Afr. et Amer. 235, pl. 20, fig. 1.
Ranatra nigra, H.-Schf., Wanz. Ins. ix, 32, tab. 290. fig. L.

Inhabits Texas, the Southern States, and the Atlantic region.

2. *R. quadridentata.*

Ranatra quadridentata, Stål, Öfv. Vetensk. Akad. Förhandl. 1861, 204.

Inhabits Texas, Mexico, California, Arizona, Illinois, and the Southern States.

NOTONECTIDÆ.

NOTONECTA, Linn.

N. insulata.

Notonecta insulata, Kirby, Fauna Bor.-Amer. iv, 285, No. 399
Notonecta rugosa, Fieb., Rhynchotographien, 52, No. 7.

Mountains of Colorado, July (Lieutenant Carpenter).

The immediate vicinity of Baltimore no longer admits this species, although it at one time inhabited the pools of spring-water, as well as the little basins themselves which the springs excavated in their outward flow. Now, the waters are polluted by the foulness of the drainage, while many of them have become obliterated by drying up. Still, at a distance of twenty miles or more from the city, here and there a basin of clear cold spring-water still remains, and in this a few specimens may be occasionally met with.

Our common species, the *N. undulate*, Say, on the contrary, inhabits the foulest pools. And in the dirty slush occasioned by the drainage of slaughter-houses, and in the slimy ponds attached to some of our brick-yards, it revels as if in full enjoyment of the filth.

CORISIDÆ.

CORIXA, Geoff.

1. *C. sutilis.* New sp.

Long and moderately narrow; dark brown, opaque, marked with testaceous. Head angular; face moderately broad, pale testaceous, with a range of golden bristles along the margins, inferiorly, of the fovea of the male, and at the apex of the epistoma is a dense tuft of similar, but longer, bristles. Outer margins of the fovea carinated, and the adjoining surface coarsely punctate; the fore part of cranium embrowned, and with three or four series of coarse shallow punctures each side; middle line elevated, tapering posteriorly, and terminating in an acute point on the angular tip of the occiput; posterior edges of the head carinately elevated. Pronotum short, broad-cordate, emarginate in front, rastrated, with twelve to fourteen closely-placed yellow lines, of which two or three on the middle are forked at the ends; medial line acutely, almost percurrently, carinate; lateral margins brown. Pleura dull black, the upper part of the pieces more or less broadly testaceous. Legs pale testaceous; palæ falcate, a little curved at tip, moderately narrow, tapering, acute, scarcely differing in the two sexes. Clavus and base of the corium finely rastrated, the apical part of the latter minutely shagreened, yellow lines of the former complete at base, sometimes a little forked at both ends; those farther back are broken into two ranges, and appear more or less angularly sigmoid; lines of the corium forming four or five longitudinal series of close, angularly sigmoid lines; those of the membrane longer, vermiculate. Tergum dull black, but the connexivum and posterior margin of the segments testaceous. Venter black at base, sometimes black as far as to the posterior part of the fourth segment. The ventral surface is usually less marked with black in the females than in the males.

Length to tip of hemelytra, 10 millimeters; width across the pronotum, 3 millimeters.

Collected in the mountains of Colorado, by Lieutenant Carpenter, July to September.

The very acutely angular occiput, with its carina and raised edges,

and the sharply-defined carina of the pronotum, will readily distinguish this species from its congeners.

At the extreme apex of the occiput is a minute notch to fit over and admit the carina of the pronotum.

2. *C. vulnerata.*

Corixa vulnerata, Uhler, Proc. Acad. Phila. 1861, 284.

Inhabits Montana, Oregon, and Northern Illinois. Common in many sections of the Northwestern Territories of the United States, and no doubt yet to be discovered in British Columbia and Canada.

3. *C. interrupta.*

Corixa interrupta, Say, Journ. Acad. Phila. iv, 328, No. 1.
Corisa interrupta, Fieb. Species Generis Corisa, 27, No. 28.

Inhabits California, Missouri, Illinois, New England, New York, Maryland, and Minnesota. Said by Fieber to be found also in Mexico and Brazil.

It presents some variation in the depth of color, and in the distinctness of the lines of the pronotum and hemelytra.

4. *C. decolor.*

Corixa decolor, Uhler, in Packard's Insects Inhabiting Salt-Water, Silliman's Journal, 1871, 106.

From Clear Lake, California; collected by Professor Torrey.

The soft and tender condition of the two specimens examined leaves a doubt of their being in fully-matured condition. It is important to have full series of these insects from the various kinds of lakes, ponds, and streams, particularly from the alkaline ones, so that something may be settled respecting the influence of such waters upon them.

5. *C. calva.*

Corixa calva, Say, Heteropt. New Harmony, 38, No. 1; Fieb., Generis Corisa, 19, No. 12.

Inhabits Pennsylvania, Massachusetts, Canada, Texas, and Alaska (*teste* Fieber).

6. *C. abdominalis.*

Corixa abdominalis, Say, Heteropt. New Harmony, 38, No. 2.
Corixa bimaculata, Guér., Iconographie Règne Animal, 353.

Inhabits Mexico, California, and Texas.

7. *C. præusta.*

Corixa præusta, Fieb., Species Generis Corisa, 28, No. 30, tab. i, 17, figs. 1–18.

Inhabits Sitka and Alaska.

8. *C. striata.*

Corixa striata, Kirby, Fauna Bor.-Amer. iv, 283, No. 1.
Notonecta striata, Linn., Fauna Suecicæ, 904.

Inhabits British America and Nebraska, and seems to extend around the world in the northern division of the north-temperate zone.

9. *C. fossarum.*

Corixa fossarum, Leach, Linn. Trans. xii, 17, No. 4; *idem,* Fieb., l. c., 32, No. 37

Inhabits California and Northern Europe.

10. *C. Germarii.*

Corixa Germarii, Fieb., l. c., 38, No. 48.

Inhabits Alaska and Northern Europe.

11. *C. mercenaria.*

Corixa mercenaria, Say, Heteropt. New Harmony, 39, No. 3.

Inhabits Mexico, California, &c.

12. *C. Escheri.*

Corisa Escheri, Heer, Insektenfauna von Oeningen, iii, Rhynchoten, 87 (foot-note.)

Above blackish-fuscous; pronotum with eight transverse lines; lineoles of the hemelytra almost parallel, black, angularly waved; front, pectus, and legs pale-yellowish. Head pale-yellowish, with dusky, blackish eyes. Pronotum very short, with a not very distinct medial carina; the first five transverse lines simple and parallel; the succeeding ones branching. Clavus distinctly rastrated, having short, but parallel yellow, transverse lines, the sutural interval narrow and yellow; corium also rastrated, but the rastrated lines obsolete posteriorly; membrane smooth, not rastrated; the parallel lines are subparallel, but become shorter and less regular posteriorly. Mouth, pectus, and legs pale yellow; the palæ stout, narrowing toward the tip, inferiorly with two series of slender bristles. Venter pale-yellowish; the bases of the segments shaded with blackish.

Length, 5 lines.

Inhabits New Georgia, coast of Washington Territory.

This translation of the original description is introduced here for the benefit of the many entomologists who are not likely ever to see the rare volume in which it so unexpectedly occurs; also in the hope that it may meet with attention from those who are favorably situated for recovering and placing within the reach of American students this conspicuous representative of the fauna of the Pacific coast.

SUBORDER HOMOPTERA.

Rostrum attached to the forepart of the head; the front situated either anteriorly or beneath, but not superiorly; the hemelytra homonomous, usually slanting in opposite directions, as the roof of a house.

The species are aërial and plant-feeders, and none are aquatic. Legs formed for walking or leaping.

FAMILY STRIDULANTIA.

CICADA, Fab.

1. *C. rimosa.*

Cicada rimosa, Say, Journ. Acad. Phila. vi, 235, No. 2.

Obtained at Ogden, Utah, by Prof. Cyrus Thomas.

2. *C. synodica.*

Cicada synodica, Say, Journ. Acad. Phila. iv, 334, No. 6.

This pretty little species seems to be common in Eastern Colorado. The present specimens were collected in that region by Mr. B. H. Smith and by Prof. C. Thomas.

3. *C. dorsata.*

Cicada dorsata, Say, Journ. Acad. Phila. iv, 331, No. 3.

This is the grandest and most beautiful of the large western species of *Cicada*. Its note is said to be loud, piercing, and sustained, and from the great strength of the base of the wings and their fasciculæ of muscles the species must be one of the most vigorous and rapid in flight.

The specimens here noticed were collected in Colorado by Prof. C. Thomas.

4. *C. canicularis.*

C. canicularis, Harris, Insects of Mass. 217, fig. 88.

From the mountains of Colorado. The specimen corresponds in size, structure, and markings with those from Eastern Massachusetts and other parts of New England. New Jersey seems to be the region where it varies most in size and kind of marking.

5. *C. hesperia.* New sp.

Form and general appearance of *C. rimosa.* Fusco-piceous, or, when less mature, dull ochreous; the surface generally invested with yellowish prostrate pubescence, the sutures and depressions with erect pubescence. Head narrower than the front of pronotum; face densely pubescent; the outer margins, central line, orbital prominences, and basal joint of rostrum orange-yellow; frontal ridge and lower part of cheeks coated with prostrate pubescence; the outer region of the cheeks having long hairy pubescence. Rostrum reaching to the intermediate trochanters. Cranium with dense prostrate pubescence; central longitudinal line impressed; running from the ocelli each side obliquely is a similar impressed line; suprafrontal space tabulate, depressed, having the central ocellus deeply seated in a large lunate excavation. Antennæ black. Pronotum obliquely narrowing and declining anteriorly; the lateral and posterior margins yellow; oblique impressions each side of disk ochreous; anterior margin and posterior submargin linearly elevated; the posterior margin broadly sinuated each side; the posterior angles produced obliquely, and elevated in a broad flap with rounded angles, the surface of the flap obliquely striated; lateral margin in front of the flap sinuated, directed downward; anteriorly to this the margin proceeds upward, and is tabular as far as to the angularly-toothed anterior angle. Mesonotum smooth; the latero-posterior margins sinuated, yellow; the disk is marked with four angular yellow spots. Wing-covers infuscated on the basal half, the nervures fuscous, and the posterior basal flap bright red; costal edge yellowish; wings at base and nearly the whole of the basal flap red; beyond the base, the nervures are more or less bounded with fuscous. First apical areole shorter than the second, and about half as wide, elongate-elliptical, acute at both ends. Pectus pale yellowish; disks of the pleural pieces blackish. Legs testaceous, but more or less suffused with piceous, particularly upon the tarsi and upon the anterior pairs of femora. Tergum yellow on the posterior margin and sides of the segments, excepting the basal one; venter, excepting the base, but including the genital covers, testaceous. Apex of the last ventral segment bilobate. Posterior margin of the last tergal segment subentire. Penis-sheath elliptical, narrowed, and sinuated each side from beyond the middle to the tip, the apex curved downward; inferior genital-cover rounded at base, acutely tapering at tip.

Length, exclusive of genital-cover, 19 millimeters; expanse of wings, 51 millimeters; width of base of pronotum, 9 millimeters.

Collected in the vicinity of Denver City, Col., by C. Thomas.

This species is closely related to *C. rimosa*, Say, and must be referred to the same subdivision of the genus. It differs most from that species in the shape of the head, sides of pronotum, and form of genital pieces. Nevertheless, I do not doubt that, when all the heteromorphs of *C. rimosa* have been sufficiently studied in the regions which they affect, local forms will be discovered to connect all the extremes into one complete species-cycle. Enough is already known of the influences of soil, physical and chemical agencies, excess or insufficiency of nourishment, and of extremes or sudden emergencies of weather to show us that certain flexible types of insect-life are changed thereby, but which may continue fixed in a particular type in the region where the conditions remain stable. Transportation from one locality to another of a different kind also stamps characters suitable to the changed conditions of life of the species.

6. *C. areolata.*

Cicada areolata, Uhler, Proc. Phila. Acad. 1861, 285.

Collected in Cache Valley, Utah, by C. Thomas, but previously known from San Mateo, Cal. (A. Agassiz); from Ogden, Utah; from Virginia City, Nev. (J. Behrens); and from Washington Territory.

Family MEMBRACIDÆ.

Ceresa, Fairm.

1. *C. diceros.*

Membracis diceros, Say, Long's Expedition, appendix, 299.

Obtained at La Bonte by C. Thomas. This species is very widely distributed throughout temperate North America.

2. *C. bubalus.*

Membracis bubalus, Fab., Ent. Syst. iv, 14.

Common in most parts of the United States. The present specimens were collected in Wyoming Territory by C. Thomas. In Maryland, this species is exceedingly abundant in late summer on the twigs and leaves of the willows growing in damp and wet situations. It varies somewhat in colors, but remarkably in the form of the pronotum. The lateral angles of the pronotum are produced and curved in some; in others, short and blunt; in others, straight and acute; and, in still others, slender, acute, and with a hollowed space in front of the pronotum. Usually, they are almost uniform pea-green; but varieties occur which are more or less mottled, and marked with rufous or fuscous.

Lieut. W. B. Carpenter found this species in the vicinity of Eagle River, Colorado, in August, 1873, and also in various other parts of Colorado from June to September.

Enchenopa, Amyot & Serv.

E. curvata.

Membracis curvata, Fab., Syst. Rhyng. 13, No. 34.
Membracis latipes, Say, Long's Exped. ii, 302, 5.

One specimen from Eagle River, Colorado, August 29, by Lieut. W. B. Carpenter.

TELAMONA, Fitch.

T. querci.

Telamona querci, Fitch, Fourth Annual Report of the State Cabinet New York, 51, No. 8.

A single specimen of a pale variety, destitute of the usual dorsal vitta, was collected by Lieutenant Carpenter in Colorado. It agrees in shape with specimens from New York and elsewhere, but differs in being pale brown, almost uniform. This may be an immature specimen, and the alcohol in which it was placed has deprived it of its original colors.

ARCHASIA, Stål.

A. galeata.

Membracis galeata, Fab., Syst. Rhyng. 9, No. 13.
Smilia auriculata, Fitch, Fourth Report, 49, No. 7.

Collected in Utah by C. Thomas. The species is widely distributed in the United States, but does not seem to be very abundant in any of the localities yet reported. It differs much in the altitude and degree of curvature of the pronotum, as well as in its breadth and sharpness. Specimens from Utah appear to be as large and high as any from the most favorable regions of Illinois and Georgia.

This and *Smilia camelus*, Fab., are the only conspicuous representatives of the great group of Membracids which form such a remarkable feature of the homopterous fauna of tropical America. In these, we have the most agreeable green color, delicately mottled with a lighter tone, or with rose, slightly flecked with black on the summit of the pronotum. In strong contrast with these, the South American species are black, with pale bands or spots, or of some pale color, with black stripes or spots. In a very few of them only do we meet with red markings.

PUBLILIA, Stål.

1. *P. concava.*

Membracis concava, Say, Long's Expedition, appendix ii, 301.

From Utah, collected by C. Thomas. It inhabits most of the regions in the eastern part of the United States; but this is the first time that it has been recorded from west of the Missouri.

There is a system of reticulated raised lines on the sides of the pronotum, which give the appearance of neuration as belonging to the corium of certain Lepyronias. This is quite deceptive to the unpracticed eye, and might lead to the supposition that the hemelytra have been soldered together. Such is not the case, however, and the true hemelytra, although largely covered by the pronotum, are still present and perfectly developed.

2. *P. modesta.* New sp.

General form of *P. concava*, Say, but more decidedly vertical in front, and with the dorsal outline scarcely depressed before the middle; apex of the pronotum more slender and acute. Color pale yellow; the head and fore part of pronotum clouded with pale brown; a spot above the humeri, a broad oblique band behind the middle, and a broad cloud on the apex grayish-brown; the dorsal edge irregularly spotted with dark brown, and the oblique band surmounted by a large brown spot. The surface closely beset with series of coarse sunken punctures; the longitudinal and reticulated surface-lines obsolete. Humeral margin of the

sinus waved. Under side piceo-testaceous; the front, clypeus, pectus, and venter, excepting the edges of the segments, black-piceous. Legs dull yellow, closely pubescent, clouded, and spotted with brown.

Length, 4 to 4½ millimeters. Breadth of pronotum, 2 millimeters.

Colorado (C. Thomas); also discovered in Utah, Dakota, Arizona, New Mexico, and California.

In two specimens examined, the commonly raised lines on the surface of the pronotum were obliterated.

ACUTALIS, Fairm.

1. *A. tartarea.*

Membracis tartarea, Say Journ. Acad. Phila. vi, 242, No. 1.

Utah; collected by Prof. Cyrus Thomas. It inhabits also the eastern region of the United States from Massachusetts to Florida. A variety of this species lacks the opaque-black color of the hemelytra, and has instead a clear hyaline throughout.

The other representatives of this genus in North America are the following, which, from their wide distribution, will probably be discovered hereafter in several of the Western Territories:—

2. *A. semicrema.*

Membracis semicrema, Say, Journ. Acad. Phila. vi, 242, No. 2.
Acutalis anticonigra, Fairm., Ann. Soc. Ent. France, sér. 2, iv, 1846, 498, No. 7.

Thus far discovered in Florida, Mississippi, New York, and Mexico.

3. *A. dorsalis.*

Tragopa dorsalis, Fitch, Fourth Annual Report Regents N. Y. State Cabinet, 52.

Originally described from New York, but it has since been found in Texas. Differs from *tartarea*, Say, in being more finely punctate, and in having more slender nervules, and larger areoles in the hemelytra.

4. *A. calva.*

Membracis calva, Say, Journ. Acad. Phila. vi, 242, No. 3.
Smilia flavipennis, Germar, Silb. Revue Ent. iii, 240, No. 16.
Acutalis flavipennis, Fairm., Ann. Soc. Ent. Fr., sér. 2, iv, 497, No. 5.

Common in Pennsylvania and Maryland, on a species of *Eupatorium*, which bears a pink flower. Also found in Texas, Mexico, Florida, and Massachusetts.

It is variable in the arrangement of the black and yellow, particularly above. Such is also the case with the other species cited above.

CYRTOSIA, Fitch.

C. fenestrata.

Cyrtosia fenestrata, Fitch, Fourth Annual Report State Cabinet, 49, No. 2.

Colorado; collected by C. Thomas. Common in the Atlantic region, and also found in Dakota.

FAMILY CERCOPIDÆ.

APHROPHORA, Germ.

A. permutata. New sp.

Pale olive-brown; form of *A. parallela*, Say. Face soiled yellow; front prominent, the cross-ridges coarse and distinct, the middle

faintly embrowned and distinctly indented. Rostrum dull testaceous, piceous at tip, reaching upon the second ventral segment. Cranium scooped out, the anterior edge sharp and curved upward; the surface coarsely and irregularly punctate in the depressed spaces, but more regularly on the rounded central lobe, this lobe deeper brown, fuscous behind, and with a medial pale line; ocelli red; occipital margin triangularly excavated to receive the produced triangular front of the middle of the pronotum, the margin each side elevated, and the base of median line elevated. Pronotum a little shorter than in *A. parallela*, Say, the lateral margin deeply sinuated and not slanting so narrowly; surface a little clouded with brown, distinctly and irregularly punctate, the punctures more dense anteriorly and on the sides; the disk convexly elevated, deeply sunken before the anterior margin, and twice depressed each side, the middle line pale, slender, feebly elevated. Scutellum pale ochreous, finely punctate, depressed, and infuscated in the middle, and with the tip paler and very acute. Legs pale testaceous, the femora more or less clouded with brown, and the incisures of the tarsi piceous. Hemelytra pale brown to beyond the middle, the apical portion brownish-white, with dark nervures; base, an entire oblique band before the middle, and a similar shorter one behind the middle dark brown, both these bands margined posteriorly with whitish, coalescing spots, some of which are occasionally carried back upon the middle of the disk. Wings brownish-white. Tergum ochreous; venter and pectus pale testaceous, the latter sometimes with brown spots on the middle coxæ and disks of the posterior pleural segments.

Length to tip of hemelytra, 8½ to 12 millimeters. Width across base of pronotum, 3 to 3½ millimeters.

Collected in Colorado and Utah by the surveys; but sent to me on several occasions, from near San Francisco, by the kindness of James Behrens.

It varies so much in depth of colors and pattern of marking that it is almost impossible to characterize the varieties. One of these varieties is almost a fac-simile of the European *A. corticea*, Germar.

2. *A. quadrangularis.*

Cercopis quadrangularis, Say, Journ. Acad. Phila. iv, 335.

Colorado and Utah; collected by the surveys.

This species is found widely spread over the country from Maine to Florida and from Texas to Dakota.

PHILÆNUS, Stål.

1. *P. abjectus.* New sp.

Fuscous, paler, with a tinge of ochreous on the head and front of pronotum, densely golden pubescent above, hoary pubescent beneath. General form of *L. coleoptrata*, Linn., but with a slightly more acute head. Cranium very finely punctate, densely pubescent, the frontal lobe margined with black, as also the occipital edge; ocelli black, placed on short, sunken, black lines; front ochreous, pubescent, the transverse ridges black, central line coarsely punctate, depressed; superior cheeks, with a broad whitish vitta, which is densely hoary pubescent; inferior cheeks piceous, paler below; rostrum pale piceous, darker on the sides, reaching to the posterior coxæ; antennæ piceous, paler at base. Anterior rim of head a little thickened, slightly raised above the surface of the cranium, and channeled from the central lobe to the eyes. Pronotum brown, clouded with fuscous, densely pubescent, irregularly and

unequally punctate, the posterior margin triangularly emarginate, the anterior margin angularly curved, the disk convexly elevated; in front of it the surface is broadly depressed, having on the submargin an indentation in which a pair of black, impressed dots are placed, and on each side two round indentations, and near the lateral margin a still smaller, less distinct one; lateral angles a little prominent, the edge acute. Scutellum reddish-brown, depressed in the center. Pectus yellow, the lateral pieces and sternum more or less piceous. Legs ochreous, the anterior and intermediate pairs brownish or piceous, the tips of the tibial spines and the ends of the tarsal joints black. Hemelytra pale reddish-brown, paler at tip, an angular spot near the base in the costal areole, and a large spot on the disk running to the inner margin, as also most of the clavus, piceous-blackish; between the spots on the costal areole is a large whitish spot; nervures of the apex a little ramose, dark piceous; costal margin at base pale; wings pale brownish, the nervures piceous. Venter rufo-piceous, with the incisures of the segments paler.

Length to tip of hemelytra, 6 to 7 millimeters. Width of base of pronotum, 2 to 2½ millimeters.

Collected in Colorado by Prof. Cyrus Thomas and others.

2. *P. lineatus.*

Cicada lineata, Linn., Systema Naturæ [ed. 12], 709, No. 31.

Collected on the hills and high mountains of Colorado by Lieutenant Carpenter, and in Colorado by Prof. C. Thomas and others. This species is widely distributed in North America. My friend, the lamented Robert Kennicott, collected specimens in the vicinity of the Yukon River, Russian America, as well as in many places along the route of his expedition from the Red River of Minnesota to the region of the Mackenzie River. On the eastern side of the continent, it extends from the Hudson Bay region to near Chelsea, Mass. Near Portland, Me., I found it to be very common on plants and low bushes in damp situations. It, also, inhabits Newfoundland, Nova Scotia, and Canada. A variety is the *Aphrophora bilineata*, Say (Journ. Acad. Phila., vi, 304). It was originally described from Sweden, and has been often reported from the various countries of the north of Europe, including Great Britain. As I have seen specimens also from Siberia, Kamtschatka, and Japan, it seems certain that this species is now spread around the circuit of the globe in the north-temperate and sub-arctic regions.

Suitable conditions of wind and current, as well as the medium of commercial transportation, have furnished agencies capable of distributing this insect from the Asiatic continent to the North American; and the abundance of specimens occurring in the localities where it is found shows how well it has adjusted itself to the variety of physical conditions with which it has had to contend.

3. *P. spumaria.*

Cicada spumaria, Linn., Fallen Hemipt. Suecicæ, 14, No. 5.

Originally described from Northern Europe. But it is now known to inhabit also England, Germany, and Switzerland. I have examined one or other of its numerous varieties from Utah, Dakota, Sitka, Lake Winnipeg, and on the eastern side of the continent from Nova Scotia, Canada, Maine, and New York. Near Brunswick, Me., it is quite common, and presents a great number of varieties, some of which are identical with those of England.

Lepyronia, Amyot & Serv

L. angulifera. New sp.

A broad, short, gibbous species, rather more inflated than the dwarf specimens of *L. coleoptrata*, Linn. Pale fuscous or grayish-brown, closely coated with small, prostrate, golden or hoary, pubescence, the upper surface minutely and closely punctate. Head a little more than one-half as long as the width between the eyes; the cranium depressed, indented each side of base and on the basal prominence; each side of submargin, center of tylus, and a short transverse line near the anterior angle of each eye impressed; tylus with a short carina near the base; anterior edge of head a little recurved, triangularly rounded. Face and under side of body piceo-fuscous; the front broad, a little flattened on the middle line; antennæ piceous, and, excepting the basal joints, as fine as a hair. Pronotum short, the anterior margin straight, the latero-posterior margins feebly sinuated, the lateral margins short, direct, a little oblique; surface deeply impressed on the middle line as far as the center of the disk, the disk a little convex, each side of it anteriorly with about three round indentations, the anterior submargin with an impressed point each side behind the eyes. Scutellum obsoletely grooved on the middle, the apex whitish; just behind it is a blackish spot. Legs dark piceous, more or less rufescent, scabrous, sericeous pubescent; the femora with a medial and apical yellow band, the under side longitudinally grooved; spines of tibiæ and tarsi yellow, tipped with black. Hemelytra paler posteriorly, more or less clouded with fuscous, minutely punctured and shagreened, with an oblique, fuscous, macular band at the base of the membrane; nervures dark fuscous, or black, with the apical ends of a few of them forked; costal margin broadly arched, and with a pale spot before and another behind the middle, sometimes also with a few pale dots aggregated near the middle and inner margin. Abdomen dark fusco-piceous, margined with pale ochreous, the genital pieces usually ochreous, with the ovipositor and outer margins piceous.

Length to tip of hemelytra, 5 to 6 millimeters. Width of base of pronotum, $1\frac{1}{2}$ to $1\frac{3}{4}$ millimeters.

Collected for me in Northwestern Florida in July by Miss Modeste Hunter. Found by myself in a low marshy spot adjacent to spring-water, a few miles south of Baltimore, August 14; also in Ocean County, New Jersey, in *Sphagnum* swamps, in August. I have also examined specimens from Cuba, Texas, and Northern Mexico.

As the Mexican hemipterous fauna extends into New Mexico and Arizona, we may safely premise that this species will hereafter be collected in these Territories.

Clastoptera, Germ.

C. delicata. New sp.

Form of *C. proteus*, Fitch, but with a more prominent front. Pale greenish-yellow. Head broad, apparently impunctate; cranium short, transversely depressed, as is also the tylus; anterior edge of the vertex carinately elevated, bordered from eye to eye with a black line; eyes margined behind with black; front smooth, polished, bright yellow, rounded, the transverse rugæ substituted by slender black bands; lower down grooved, and with a broad black spot, adjoining which each side on the cheeks is a smaller spot; under side bright yellow; rostrum black, reaching almost to the posterior coxæ; antennæ black at base.

Pronotum banded on the anterior edge by a slender black line, and with five straighter and more slender lines, which stop just short of the lateral margins, these lines feebly impressed, and obsoletely, minutely scabrous; surface not wrinkled, almost smooth, moderately convex, deeply emarginated behind, the lateral margin narrowly produced as far as the outer line of the eyes; the humeral margin recurved, and with a small black dot before it. Scutellum pubescent, yellow, transversely wrinkled, with a slender black line at base, and an interrupted one behind the middle. Hemelytra with short, remote, golden pubescence, coarsely punctate at base, more obsoletely so posteriorly; the inner and posterior margins, the suture between the corium and clavus, an oblique short streak on the disk, and a spot on the middle of the costa fuscous; posterior margin of the corium with a sinuous brown band, the membrane and posterior one-third of the corium, and a spot at base of costa pale brown; the bulla very prominent, black; under side yellow; the mesostethium, disks of the pleural pieces, and middle line of genital segment pitch-black. Legs yellow, the tibiæ having a band below the knee, another on the middle, and a third at tip, and the spines of tibiæ and tarsi, including the nails, dark piceous.

Length to tip of hemelytra, 4½ millimeters. Width of pronotum, 2 millimeters.

Colorado and Utah; collected by C. Thomas and B. H. Smith.

FAMILY FULGORIDÆ.

SCOLOPS, Germ.

1. *S. sulcipes.*

Fulgora sulcipes, Say, Journ. Acad. Phila. iv, 335.

Common in many parts of the United States, as well east as west of the Mississippi River. The specimens collected by these expeditions occurred in Colorado, Utah, Dakota, and Arizona. Specimens have been examined by me which were obtained in Maine, Massachusetts, Connecticut, Rhode Island, New York, Iowa, Illinois, Pennsylvania, and Minnesota. In Maryland and Virginia, they occur in sedgy and grassy low spots in the corners of meadows, particularly in places near woods, in July, August, and September.

This species may be known from its allies by the long and very slender cephalic prominence, acute at tip, by the first ulnar nervure giving off three forking branches, and by the second ulnar giving off two forking branches, and with numerous cross-nervures producing several series of small areoles adjoining the tip.

Length from tip of head to end of hemelytra, 8½ to 10 millimeters. Length of cephalic horn, 2 to 2½ millimeters.

2. *S. hesperius.* New sp.

Straw-yellow or pale brownish, narrower than *S. sulcipes.* Cephalic protuberance shorter, broader, not compressed at tip; rostrum reaching upon the second ventral segment, the last joint black at tip; sutures of the face more or less infuscated; postocular process white, with a black dot inferiorly. Pronotum irrorated with pale brown and white, the sides and lateral pieces irregularly, obsoletely tuberculate; tegular pieces minutely, confluently punctate. Mesonotum slightly guttate with pale brown, the apex tumid and emarginate just each side of the extreme tip; metapleura and sternum whitish. Carinate lines of the coxæ and legs whitish; the spaces between usually brownish. Heme-

lytra less gibbously convex than in *S. sulcipes*, the nervures stouter, pale, and interruptedly spotted with brown, the first ulnar nervure forked beyond the middle, the second ulnar forked before the middle; the apex with but two or three series of cross-nervules; the costal area sometimes with two or three cross-nervules at tip; the costal margin very moderately arcuated. Wings milky-white, the nervures brown. Tergum reddish-brown, darker in the center; the margins of the segments and the connexivum pale-yellow.

Length from tip of head to end of hemelytra, 8 millimeters. Width of pronotum, 2¼ millimeters. Length of cephalic horn, 1½ millimeters.

Southern Colorado, C. Thomas; and Denver City, from B. H. Smith.

In the specimens which I have examined, there is an entire absence of the large black spot of the sides anteriorly of the pronotum, so conspicuous in *S. sulcipes*, Say.

3. *S. grossus*. New sp.

Shorter and more robust than *S. sulcipes;* the cephalic horn as long, but much stouter, than in that species; very wide on the upper face, and the apex blunt and vertically carinate. Sides of protuberance, cheeks, and anterior pleural pieces infuscated, guttate with whitish, the lateral keels distinctly sinuate a little distance in front of the eyes; rostrum tipped with black, reaching almost to the genital segment. Pronotum curved toward the front more narrowly than in *S. sulcipes;* the geminate indentations present, but not black; the sides a little granulose. Mesonotum short and broad, the apex feebly tumid; femora more or less dotted with brown; hemelytra short and wide, strongly arcuated, more oblique at tip than in *S. sulcipes*, clouded with brown, and with a few pale transverse patches across the corium; the nervures thick, remotely and irregularly spotted with fuscous; the first and second ulnar nervures forked on the same line just before the middle of the corium; the apical cross-nervules very few, and the costal area with four or five cross-nervules near the tip. Wings smoky-brown, with the nervures darker; tergum more or less orange, shaded with fuscous.

Length from tip of head to end of hemelytra, 8 to 8½ millimeters; Width of pronotum, 2 millimeters; length of cephalic horn, 2½ millimeters.

Collected in Texas by G. W. Belfrage.

4. *S. angustatus*. New sp.

More slender than either of the species described; the hemelytra almost flat above, hardly gibbous on the sides; head more or less orange-yellow, with the face, sides of protuberance, and ridges of the front brownish; cephalic horn very short and narrow, but blunt at tip; cranium with two black, impressed dots between the eyes; rostrum reaching to the end of the fourth ventral segment, yellow, black at tip, the lobes behind the eyes with a small black dot. Pronotum with an arcuated series of indented black points, the lateral margins obliquely curved toward the head; pale, grooved, and brown behind the eyes, and with the carinate edge whitish. Mesonotum varied with brown, and with a series of black, indented points across it, the tegular pieces a little confluently punctate; pleura washed with pale brown and flecked with dark brown; legs flecked with fuscous, the tibiæ with two or more dark, band-like shades; hemelytra infuscated, moderately flat, the costal margin very feebly arcuated, a broad longitudinal vitta extending to the tip, a streak on the suture of the clavus, several coalescing spots running

back from the apex interiorly, and the interrupted flecks on the nervures dark brown; the costal area whitish throughout, nervures stout, the first ulnar nervure forked considerably behind the middle, and the second ulnar forked at a little distance behind the middle. Wings smoky, the nervures darker. Disk of tergum black, with the sides orange-yellow. Venter faintly brownish, flecked with yellowish.

Length from tip of head to end of hemelytra, 7 to 8 millimeters. width of pronotum, $2\frac{1}{4}$ to $2\frac{1}{2}$ millimeters. Length of cephalic horn, $1\frac{1}{2}$ millimeters.

Inhabits Nebraska, Dakota, Iowa, Massachusetts, and Connecticut.

Subfamily DELPHACINA.

Liburnia, Stål.

L. vittatifrons. New sp.

Elongate-oval, pale green, bald, and polished. Apex of the head tumidly conical; cranium minutely, obsoletely punctate on the sides; the cranial shield triangular in front, so caused by the converging of the lateral carinæ; central carina high and thick, the lateral ones very high and divaricating anteriorly; the front oblique, depressed, banded twice with orange or rufous; the pair of central carinæ high, curving apart, abbreviated before the epistoma; the epistoma piceous or rufo-piceous at base; rostrum yellowish, piceous at tip, reaching to the tip of the intermediate coxae. Eyes large, horizontal, subreniform, pale brown; antennæ greenish; the scapus and basal joint subequal, the former with a broad black line, the latter with two black lines and an anterior ring; second joint longer than the two former, with two black lines. Pronotum short, truncate in front, sinuate on the posterior margin, the central line and an oblique one each side carinated, the lateral edge sinuated to receive the tegulæ; tegulæ very minutely punctured. Mesosternum longer than the pronotum, with five carinated lines, the lateral ones a little curved, and the apex slightly elevated. Legs green; the femora and tibæ, excepting the posterior pair, lineated with black, and with the tips of the spines, the nails, a broad band near the tip of the anterior tibiæ, and a large spot on each anterior coxa, black; hemelytra long and narrow, obliquely rounded at tip, yellowish-green, the nervures straight and wide apart, with only two or three cross-nervules near the tip; the radial nervure forked at the middle, the first and second ulnars forked near the tip. Wings white; tergum sometimes infuscated on the disks of the segments. Anus of the female armed with a long, acute stylet; both sexes with a few long bristles at the apex of the venter; hemelytra of the male with five longitudinal cells at the apex; the inferior genital segment divided into two curved, very acute, piceous hooks, and the anus with a still longer stylet than in the other sex.

Length to tip of hemelytra, 5 to $8\frac{1}{2}$ millimeters. Width of pronotum, $1\frac{1}{2}$ to 2 millimeters.

Inhabits Dakota, collected by Mr. Rothauer; Illinois, Robert Kennicott. It also occurs abundantly upon the salt-marshes of the seacoasts of Maryland and New Jersey, living among the long, stiff grass. When fresh and not weather-beaten, it is of a vivid light green, but when old and weathered it becomes soiled yellow in color. It would be interesting to know if this species belongs to places in the West which were originally the beds of salt-lakes. The salt-marshes of Eastern Massachusetts have thus far failed to yield any specimens of it.

Cixius, Latr.

1. *C. stigmatus.*

Flata stigmata, Say, Journ. Acad. Phila. iv, 336, No. 3.
Cixius stigmatus, Fitch, Catal. of State Cabinet N. Y. 45, No. 1.

Inhabits Missouri, Texas, Colorado, Illinois, Michigan, Canada, and the Atlantic region generally.

2. *C. Franciscanus.*

Cixius Franciscanus, Stål, Eugenies Resa, Entom. Bidrag, 273, No. 151.

Inhabits California, near San Francisco.

Orgerius, Stål.

O. rhyparus.

Orgerius rhyparus, Stål, Eugenies Resa. 274, No. 154.

Inhabits California, near San Francisco.

Delphax, Fab.

D. tricarinata.

Delphax tricarinata, Say, Journ. Acad. Phila. iv, 337.

Inhabits Nebraska, Missouri, and Illinois.

This may perhaps belong to the genus *Liburnia*, but I have not at present any specimens at hand to enable me to determine its precise characters.

Bruchomorpha, Newm.

1. *B. oculata.*

Bruchomorpha oculata, Newman, Entom. Mag. v, 399.

Inabits Texas, Indian Territory, Colorado, Nebraska, Illinois, and the Atlantic region.

2. *B. dorsata.*

Bruchomorpha dorsata, Fitch, Third Report, 396, No. 114.

Inhabits Indian Territory and Texas.

Naso, Fitch.

N. Robertsonii.

Naso Robertsonii, Fitch, Third Report, 396, No. 115.

Inhabits Indian Territory, Illinois, and Maryland.

Phylloscelis, Germ.

P. atra.

Phylloscelis atra, Germar, Zeits. f. d. Entom. i, 192, No. 2.

Inhabits Texas, Indian Territory, Illinois, Pennsylvania, Maryland, Virginia, North Carolina, and Georgia.

Issus, Fab.

1. *I. auroreus.* New sp.

Form similar to *I. aciculatus;* bright yellow, saturated with clear brown. Cranium pale brownish, transverse, quadrangular, with the margins prominently elevated, the front edge indented in the center, and the lateral edge obliquely indented posteriorly, the posterior margin concave; front a little longer than wide, slightly convex, a little wider infe-

riorly, and with the sides curving inward to concur with the margin of the epistoma, the lateral margins dotted with fuscous; on the disk are a few fuscous flecks; the central carina feeble, almost obsolete beneath; sides of the face smooth, yellow; epistoma shorter than the front, prominently convex and ridged, the middle line thick, pale yellow, each side of it obliquely striated with brown; antennæ fuscous; rostrum reaching to the posterior coxæ, ochreous, piceous at tip; pronotum longer than the cranium, ochreous, dotted with brown, on the middle with two indented points, the anterior margin broadly arcuated to fit the cranium, the posterior margin truncated; mesonotum pale yellow, with a blunt thick carina on the middle, the surface depressed each side, and the apex a little tumid; pleural pieces pale yellow, the anterior ones margined and spotted above with fuscous or pale brown; legs piceous at base of femora, and some patches, particularly on the forward surface, and the outer face of tibiæ pale testaceous; tips of the spines and the nails piceous-black; hemelytra short and broad, clear wine-brown, pale orange on the costal areole, the nervules of this part obsolete, apex bluntly rounded, base narrower than the width beyond the middle, the surface coarsely and irregularly scabrous, longitudinal nervures parallel, distinct, a few areoles present near the apex, and these irregular, reticulated, and indistinct; abdomen greenish-yellow, more or less saturated with rosy-orange; the genital segments fuscous, with the hooks rufo-piceous.

Length to tip of hemelytra, 5 millimeters. Width of pronotum, $1\frac{1}{2}$ millimeters.

Inhabits Texas; collected by G. W. Belfrage.

2. *I. aciculatus.* New. sp.

Short, robust, grayish testaceous, minutely punctate with fuscous; upper side of head about as long as the pronotum, transverse, quadrangular, ochreous, concave, each side with an arcuated fuscous line, and some fuscous points and specks, the anterior margin a little elevated, scooped out in the center, the posterior margin prominently carinate, broadly sinuate; front a little longer than broad, pale ochreous, irregularly punctate, a transverse band above, a geminate spot below, and numerous dots, more or less aggregated near the outer margins, fuscous, the lateral margins carinate, arcuated; central carina percurrent to the base of rostrum, pale, the carinæ each side not much elevated, the inferior margin triangular; epistoma shorter than the front, moderately convex, obliquely striated with fuscous, and infuscated inferiorly; antennae infuscated; rostrum reaching behind the posterior coxæ; pronotum ochreous, regularly and remotely dotted with fuscous, the anterior margin broadly arcuated, and the posterior margin straight; propleura fuscous, but with the base and margins ochreous, remotely dotted with fuscous, and with some fuscous traces on the middle, the middle line sulcated; meso- and meta-pleura ochreous and white; legs pale ochreous, three bands on the femora, the exterior surface of the tibiæ somewhat, the spines and tarsal joints infuscated; the femoral grooves and tibial carinæ well defined; hemelytra short, broad, dotted with fuscous, narrower at base, the apex obliquely rounded; nervures stout, wide apart, pale, margined with fuscous; the areoles from behind the middle to the tip large, trapezoidal, or irregularly quadrangular, forming about five series; the inner and outer submargins and the disk a little washed with fuscous and pale testaceous; the genital pieces fuscous beneath.

Length to tip of hemelytra, 5 millimeters. Width of pronotum, 2 millimeters.

Inhabits Orange Springs, Florida, collected in June by Miss Modeste Hunter; also Texas, G. W. Belfrage.

This species closely resembles *Issusimmaculatus*, Fab.; but the shape of the front and its carinate lines will at once mark its distinctness.

TYLANA, Stål.

1. *T. ustulata.* New sp.

Resembles *T. conspersa*, Walker, but having the nervures much coarser and densely reticulated near the apex; short and robust; color pale or bright ochreous yellow, clouded with fuscous. Head ochreous, smooth, obsoletely rugulose, the cranium deeply scooped out, much wider than long, bounded each by high ridges, which are much elevated before and behind the eyes, and marked with large black spots; the middle indented, yellow, each side of it are two broad, irregularly arcuated, black spots, the lateral edge interruptedly piceous; posterior margin concave, yellow; anterior margin concave, piceous, indented in the middle, slenderly carinate; front minutely punctate, the middle longitudinally elevated, and with the central line slenderly carinated, each side of it longitudinally, broadly grooved and carinated, the carinæ abbreviated, slightly curving inward at the ends; the surface irregularly mottled with piceous, the upper angles entirely piceous, and below the line of the eyes is a broad piceous band, which continues along the sides and across the propleura upon the tegulæ; eyes pale brownish, the piece behind them yellow, with two piceous spots; epistoma piceous beneath, the central carina prominent, blunt, each side of it somewhat ribbed with piceous; rostrum piceous, pubescent, reaching beyond the middle coxæ. Pronotum about one-third as long as its width, dark ochreous, dotted with piceous and yellow, the middle scooped out, minutely scabrous, infuscated, with a fuscous band posteriorly, on which are two indented points, and the anterior submargin fuscous; mesonotum about half as long as its width, pale, rufo-piceous, more or less yellow each side of the central shield, and with the middle line slender and yellow, the shield minutely scabrous, impressed around the submargins and behind, the margins carinated; lateral angles infuscated, a little interiorly is a short, blunt carina, and the surface next to the shield depressed. Anterior pleural pieces broadly black above, and a little so beneath; the sternum yellow. Legs piceous, more or less yellow at base; femora banded thrice with ochreous, the tibiæ with two ochreous spots on the outer edge; tarsi and the spines and nails piceous. Hemelytra ochreous, clouded with fuscous, and with minute fuscous points; the nervures very thick and prominent, blackish piceous, interrupted with ochreous at base and on the disk, and with an ochreous dot at the tip of each cross-vein on the costa and tip; nervures from the middle to apex forming a close net-work of mostly pentagonal areoles. Tergum marked transversely with piceous; venter dotted and spotted with piceous and black, remotely pubescent.

Length to tip of hemelytra, 7 millimeters. Width of pronotum, $2\frac{3}{4}$ millimeters.

Inhabits Colorado and Arizona.

The hemelytra are wider at tip than at base; the costal area is wide; the cross-nervules of the base slender, less conspicuous than the others, and generally testaceous; and the costal margin is angularly produced before the middle, as usual in this group.

2. *T. ustulipunctata.* New sp.

Form similar to that of *T. elliptica*, Germar, but a little more slender; color clear brunneous, with the longitudinal veins wide apart, straight, curving down at tips, with only a few cross-veins, and those chiefly near the tip. Head ochreous, subquadrate, a little transverse, tinged with fuscous, the lateral and posterior edges prominently carinate, pale yellowish, roundedly emarginated on the posterior margin, and angularly produced on the anterior margin; front subquadrate, much longer than broad, a little arcuatedly dilated, the lower angles bent inward; superior angles subrectangular; disk with an oval ochreous spot, the surrounding surface fuscous, dotted with pale yellow; middle carina high superiorly, the lateral carinate edges prominent, pale; cheeks pale ochreous; epistoma shorter than the front, acutely triangular, ochreous, infuscated on the disk, excepting the middle line; rostrum reaching to the posterior coxæ, the tip piceous. Pronotum short, pale ochreous, a little infuscated, the center with two impressed points, and the sides with a few pale granules, the anterior margin acutely triangular, the posterior margin truncated; mesonotum longer, embrowned on the disk, striped with yellow on the sides; pleural pieces ochreous, brownish on the disks, the anterior piece with a large round black spot behind the eyes; metasternum greenish-white. Legs dull ochreous, the spines and tarsi more or less piceous, anterior and middle coxæ bright crimson. Hemelytra a little flattened, long, and much narrowed posteriorly, the apex obliquely truncated; surface with short, golden pubescence; three round black spots behind the base arranged in a triangle, and near the tip three others similarly arranged; costal areole with several piceous irregular spots, the transverse veins indistinct, pale, but extending along its whole length; wings a little embrowned, the nervures darker. Venter and tergum pale ochreous, banded with brown, the margins of the segments yellowish-white, the sides of genital segments striped with fuscous.

Length to tip of hemelytra, 8 millimeters. Width of pronotum, 3 millimeters.

Inhabits Cuba (Professor Poey and Charles Wright) and Mexico.

It resembles *T. elliptica*, Germar, but has a longer front, and lacks the carinæ, which bound a central disk in that species.

DICTYONISSUS. New gen.

Aspect of *Mycterodus;* the upper surface hispid. Vertex subquadrate, deeply scooped out, a little wider than long, prominent, the anterior angles rectangular, and with the bounding carinate lines high, the anterior margin arched in the center; front longer than wide, the sides convexly curved, the middle line carinated from the tip for about two-thirds of the length downward. Pronotum acutely triangularly narrowed anteriorly, and carried forward almost to the front line of the eyes, and deeply emarginated behind; mesonotum as long as the head and pronotum united, with the apex of the scutellum broad and bluntly rounded. Tibiæ grooved on the outer face, the posterior pair having three small teeth, exclusive of the apical one. Hemelytra long and narrow, vitreous, hispid, regularly parabolic on the costal margin, from the base to the inner apical angle, the inner margin straight; the whole surface filled with net-work of large rounded areoles composed of very coarse nervures, arranged somewhat longitudinally, but obliterating the usual series of longitudinal nervures; the costal area obliterated, excepting only at the base.

D. griphus. New sp.

Pale green, moderately long and narrow, hispid above, pubescent beneath. Head with a few coarse wrinkles on the fore part of the vertex, the anterior edge acute, interruptedly margined with fuscous; front longer than the epistoma, the lateral margins curving to conform to its outline, submargin each side with a longitudinal curved series of minute black points; epistoma transversely convex, narrow, the rostrum reaching to the posterior coxæ. Seta of antennæ black. Pronotum short, angularly lunate; anterior margin subtruncate, lateral margins greatly recurved, the sides deeply excavated to admit the eyes, middle line distinctly elevated; mesonotum very minutely scabrous, feebly carinate along the middle, the lateral carinæ almost straight. Spines of the tibiæ and tarsi tipped with piceous. Hemelytra long and narrow, strongly deflected, the nervures very thick and forming about six series of rounded areoles, the clavus with two series of areoles, but with a single series of three areoles at base. Abdomen fringed with short, stiff pubescence.

Length to tip of hemelytra, 4½ millimeters. Width of pronotum, 1¼ millimeters.

Inhabits Texas; collected near Waco by G. W. Belfrage.

This interesting little species presents a new facies in the group as represented in North America. The obliteration of the longitudinal nervures of the hemelytra and the rounded form of the areoles signalize it at once.

NEÆTHUS, Stål.

N. vitripennis.

Hysteropterum vitripenne, Stål. Öfvers. Kong. Vet. Akad. Forhandl. 1854, 247; and Eugenies Resa, 279, No. 171.

Inhabits California near San Francisco, and Arizona.

APHELONEMA. New gen.

Elongated, the sides almost parallel; head large, including the eyes a little wider than the base of the closed hemelytra; vertex very short, sublunate, with the anterior margin strongly carinate; front rounded, prominent, the central plate almost circular, flattened, and very much raised above the surrounding area; exterior margin strongly carinate, curved conformably with the margin of the central plate, the upper margin subtruncate, carinate, the middle line carinate, and continued to the tip of epistoma; epistoma prominently ridged, the inferior cheeks wide, impressed on the inner angle, the superior cheeks wide, scooped out. Pronotum longer than the vertex, lunate, bluntly curved on the anterior margin, the posterior margin deeply sinuated. Tibiæ slender, sulcate on the outer face almost to the tip. Hemelytra long and narrow, a little obliquely rounded at tip, the costal and sutural margins almost straight and parallel, the longitudinal nervures very straight, connected near the tip by a few cross-nervules, which form a transverse series of three large and one or two small, many-sided areoles, next after which is an apical series of four or five triangular areas; the costal areole with three slender cross-nervules near the tip.

A. simplex. New sp.

Pale ochreous; hemelytra faintly yellowish translucent. Vertex lunately hollowed out, the base slenderly carinate, the anterior margin bounded by a stout carina; front bright ochreous, densely minutely scabrous, the space between the central plate and the outer carinate

margin depressed, brown, spotted with yellow; epistoma very acutely triangular, brown, the margins and middle carina yellow; rostrum reaching to the middle coxæ, the superior cheeks a little brown. Pronotum shorter than the central plate of the front, a little embrowned, covered with coarse punctures set into annular orbits, the anterior margin slightly carinated, feebly waved each side of the middle; mesonotum pale brown, almost smooth on the disk, and on each side densely packed with prominent papillæ having punctured centers; pectus pale yellow, with the disks of some of the superior pieces brownish. Legs pale yellow, the femora and coxæ a little washed with brown, the tips of the spines piceous. Hemelytra pale yellowish translucent, a little dusky at tip, the nervures clearer yellow, stout, with about two series of large, irregular areoles at tip, and with three costal cross-veins behind the tip; wings yellowish, with very slender nervules. Abdomen dark brown, the segments margined behind and on each side with ochreous; the tergum in one specimen having yellow dots with ochreous centers.

Length to tip of hemelytra, 4 millimeters. Width of pronotum, 1½ millimeters.

Inhabits Dakota. Collected by Mr. Rothauer.

Family TETTIGONIDÆ.

Proconia, St. Farg. & Serv.

P. costalis.

Tettigonia costalis, Fab., Ent. Syst. suppl. 516, Nos. 22–23; Signoret, Ann. Soc. Ent. France, 3d ser. ii, 359, pl. 12, fig. 8; Fab., Syst. Rhyng. 39, No. 34.
Cercopis marginella, Fab., Syst. Rhyng. 96, No. 44.
Cercopis lateralis, Fab., Ent. Syst. suppl. 524, No. 24; Coquebert, Illustr. i, 35, tab. 9, fig. 3.
Tettigonia lugens, Walker, British Mus. Cat. Homopt. iii, 775, No. 108.
Tettigonia pyrrhotelus, Walker, l. c. iii, 775, No. 109.

Inhabits the Atlantic region from Canada to Florida, and in the West it occurs in Washington Territory, Oregon, British Columbia, Colorado, Arizona, and California. It occurs also in Mexico, Texas, and Central America.

A variety from the Southern States is black, and there is some variation noticeable in the depth and intensity of the red ground-color and in the yellow lateral stripe.

Aulacizes, Amyot & Serv.

A. irrorata.

Cicada irrorata, Fab., Ent. Syst. iv, 33, No. 24; Syst. Rhyng. 62, No. 6; Coquebert, Illustr. i, 32, tab. 8, fig. 4.
Tettigonia irrorata, Signoret, Ann. Soc. Ent. France, ser. 3, iii, 59, pl. 6, fig. 14.

Inhabits Texas, Georgia, Florida, Louisiana, Arkansas, Maryland, Pennsylvania, and New Jersey.

Diedrocephala, Spin.

1. *D. coccinea.*

Cicada coccinea, Forster, Nov. Species Insect. 69.
Tettigonia quadrivittata, Say, Journ. Acad. Phila. vi, 312, No. 3.
Proconia quadrivittata, Fitch, Catal. of Ins. of N. Y. State Cabinet, 55.

Inhabits Texas, Indian Territory, the States east of the Mississippi River, Canada, &c.

It varies much in size and color; some specimens being even almost

entirely red above. Blackberry-bushes and low shrubs are its favorite resorts, on which it may often be seen in considerable numbers during the summer.

2. *D. noveboracensis.*

Aulacizes noveboracensis, Fitch, l. c. 56, No. 2.

Inhabits the vicinity of East River, Colorado, August 29. Collected by Lieutenant Carpenter. It is common in many parts of the United States north of Maryland, and it extends far north in Canada and British Columbia.

3. *D. mollipes.*

Tettigonia mollipes, Say, Journ. Acad. Phila. vi, 312, No. 4.
Aulacizes mollipes, Fitch, l. c. 56, No. 1.

Inhabits Texas, Colorado, Mexico, and the southern part of the Atlantic region.

TETTIGONIA, Geoff.

T. hieroglyphica.

Tettigonia hieroglyphica, Say, Journ. Acad. Phila. vi, 313, No. 6.

Inhabits Texas, foot-hills and plains of Colorado) from August to October (Lieutenant Carpenter), and the Atlantic region throughout.

GYPONA, Germ.

G. octolineata.

Tettigonia octolineata, Say, Journ. Acad. Phila. iv, 340, No. 1.

Inhabits foot-hills and plains of Colorado. Collected by Lieutenant Carpenter. Also common in most parts of the Atlantic region.

SUBFAMILY JASSINA.

COCHLORHINUS. New gen.

Form similar to that of *Rhaphirhinus*. Head long triangular, produced forward into a long tapering ligula, with the surface depressed, the margins elevated, and the apex rounded. Superior cheeks sublunate, inferior ones oval, acute at both ends; front tapering superiorly and subcylindrical, subconical inferiorly, its tip much wider than the ligulate labrum. Ocelli situated on the margin in the suture between the vertex and front. Eyes placed obliquely, bordering the pronotum by most of their base, concave beneath, and bounded there by a deep suture. Second joint of the antennæ a little longer than the basal one. Pronotum short, the anterior margin arcuated, the posterior margin concave; posterior angles broadly rounded, the anterior ones almost rectangular. Hemelytra of the female about the same length as the abdomen, coarsely scabrous; behind the middle is a thick anastomosis, sending off stout branches on the costal and four longitudinal nervures; behind this are four long areoles, and beyond these are four short and wider ones arranged around the apex; the apex rounded, obliquely slanting toward the inner angle. Basal joint of the hind tarsi fully as long as the two others united.

C. pluto. New sp.

Form of *Tettigonia brevis*, Walker, but shorter, deep black, scabrous, highly polished. Head produced into a spoon-shaped tip, round at the

apex, with the margins elevated and the submarginal surface depressed, the tylus carinately elevated, reaching to the tip; front crossed by a broad yellowish band; base of rostrum pale piceous, the vertex with a broad rounded impression each side, and the occiput with a small depressed dot each side. Pronotum polished, transversely wrinkled, with an arcuated, transverse impressed line behind the anterior margin, and with about three indented points behind each eye. Scutellum dull black, very minutely rastrated, obsoletely, minutely punctured postero-exteriorly. Tibiæ, tarsi, apex of femora, and tips of the coxæ yellowish. Hemelytra shining black, coarsely scrabrous, transversely wrinkled, the anastomosis behind the middle of the corium and a point at the tip of the clavus white. Abdomen black.

Length, 6 millimeters. Breadth of pronotum, $1\frac{5}{8}$ millimeters.

Inhabits California. Received from James Behrens.

This species mimics the Tettigonias of the group of *T. brevis* so closely that it might readily be mistaken for one of them; but on close inspection, the position of the ocelli and the arrangement of the apical cells of the hemelytra will show its affinities to be with the *Jassina*.

Only females have thus far been inspected.

This is another of the striking instances of parallelism which occur in the *Hemiptera* in forms belonging to families whose affinities may be otherwise remote.

Bythoscopus, Germar.

1. *B. pallidus.*

Idiocerus pallidus, Fitch, Catalogue N. Y. State Cabinet, 59, No. 5.

Inhabits the mountains of Colorado in June. Collected by Lieutenant Carpenter. In New York, this species affects the willows and poplars.

2. *B. siccifolius.* New sp.

Dull straw-yellow, short, robust. Head very minutely punctured, and transversely wrinkled; vertex with two median longitudinal approximate brown lines each side, with a black round dot, and against each eye is a brown subtriangular spot, which sends forth a short line to the ocellus, and lower down another slender line running to the front; the front bounded by a brown, slender line, and each side with a series of brown, short lines placed somewhat obliquely; sutures of the face brown; the middle line of the labrum and rostrum dark brown. Pronotum minutely, transversely wrinkled, with an arcuated series of indented, short, brown lines and points behind the anterior submargin, middle with two brown, approximate lines, each side of which is a less distinct line, and nearer the exterior margin a deeper, brown, curved line; anterior margin broadly rounded, the posterior margin truncated. Scutellum transversely wrinkled, with a slender, impressed line crossing the middle and connecting with a submarginal similar line each side, the disk with a large dark brown spot, and a smaller one each side of base, the lateral margins pale yellow. Legs straw-yellow, femora with two brown bands, the anterior and middle tibiæ brown beneath, but with a yellow band on the middle, and with the upper side a little clouded with brown; posterior tibiæ with small brown dots at the base of the spines. Hemelytra yellowish-hyaline, the thick streaks at base, the sutural and interior margins whitish, the sutures dark brown, as also the interneural lines and inner submargin of the clavus, the nervures paler brown; apical areoles four in number, three ante-apicals, of which the inner one is shortest and the middle one much the longest. Tergum black, with

the margins and sides of the segments pale yellow; venter less widely spread with black.

Length to tip of abdomen, 3 millimeters. Width of pronotum, 1 millimeter.

Inhabits the summits of high mountains in Colorado. Collected by Lieutenant Carpenter, July 19 to September 6. Also, at Eagle River, Colorado, in August, and at Denver in June.

This is a very variable little insect, which is not confined to the region of the Rocky Mountains, but which has been found likewise in Texas, in British Columbia, Canada, and New England.

JASSUS, Germar.

J. lactus. New sp. auctor.

Greenish-yellow, moderately long and slender. Head sublunate, a little peaked at the tip of vertex, the central line incised and a little impressed on the middle, each side of this with a short, oblique impression, a large black dot occupies each side of the middle, and two minute fuscous ones are at the tip; face pale, marked with black dots against the eyes, and with two black, arcuated lines superiorly, placed on each side of the middle; front faintly striated with brown each side and above, the sutures, and sockets of the antennæ also black. Pronotum larger than the head, arcuated in front, slightly sinuated on the posterior margin, minutely wrinkled, transversely impressed on the middle behind the anterior margin, and with an impressed dot exterior to this; an impressed, oblique line placed still nearer to the lateral margin. Scutellum depressed on the middle, with an arcuated, impressed, short line each side, and a very slender, incised line behind the middle; the base with a black dot each side, extending partly beneath the pronotum. Legs yellow, the beds of the spines, the nails, and the tips of tarsal joints piceous black. Hemelytra yellowish-hyaline, the costal margin broadly thickened, minutely scabrous; nervures thick and very distinct, the areoles long and narrow, the outer one at apex shortest, composed of a short triangle at base and a longer one at tip. Tergum black at base and beyond, omitting the sides and three last segments; venter greenish-yellow, the basal incisure, a spot upon the second segment, the ovipositor, and the impressed inner angles of the connexivum black.

Length, 4 millimeters. Width of pronotum, $1\frac{1}{4}$ millimeters.

Collected by Lieutenant Carpenter in the high mountains of Colorado, from June 19 to September 6.

Some specimens have the black of the face, the pleura, and the abdomen more widely extended, and causing them to have a blackish appearance.

DELTOCEPHALUS, Burm.

D. debilis. New sp.

Bright grass-green, short and stout. Head, forepart of pronotum, and the scutellum whitish-green. The head triangular, longer than the pronotum, with the sides a little arcuated, the tip a little curved upward; cranium depressed, the median line incised; each side at base with a short impressed line; eyes continuous with the lateral line of the head, margining the pronotum almost to its base; front stained with black above and on each side, and in which are indications of striated lines; cheeks almost as wide as the eyes, black at base, the tip of labrum piceous, and the antennæ infuscated at base. Pronotum lunate, the surface a little wrinkled transversely, with a few indented points each

side and in front. Pleura blackish, margined with pale greenish. Legs yellowish, the base and tips of tarsi and the beds of the spines blackish. Scutellum a little depressed in the middle, feebly wrinkled, the lateral margin slightly elevated. Hemelytra green, paler at tip, obsoletely punctured next the nervures, the nervures stout and rather straight; four short apical cells and one costal cell, the discoidal one long and wider than either of the others. Tergum black, more or less margined with pale green, the three apical segments also pale green; venter pale green, stained with black, particularly on the disks of the segments and on the genital valves.

Length to tip of venter, $3\frac{1}{2}$ millimeters. Width of pronotum, $\frac{3}{4}$ millimeter.

Inhabits Colorado, on the sides of the high mountains, and near Fair Play, in South Park, July (Lieutenant Carpenter.)

No. 5——9

LIST OF THE FIGURES OF HEMIPTERA ON PLATES 19, 20, 21.

PLATE XIX.

FIG. 1. Eurygaster alternatus, Say.
2. Homæmus bijugis, Uhler.
3. Pachycoris torridus, Scop.
4. Odontoscelis catulus, Uhler.
5. Stiretrus fimbriatus, Say.
6. Corimelæna nitiduloides, Germ.
7. Eysarcoris melanocephalus, Fab.
8. Augocoris sexpunctatus, Fab.
9. Strachia (Murgantia) histrionica, Hahn.
10. Brochymena obscura, H. Schf.
11. Chlorochroa ligata, Say.
12. Prionosoma podopioides, Uhler.
13. Thyanta custator, Fab.
14. Podops dubius, Pal-Beauv.
15. Neottiglossa undata, Say.
16. Œbalus pugnax, Fab.
17. Cydnus (Melanæthus) picinus, Uhler.
18. Podisus cynicus, Say.

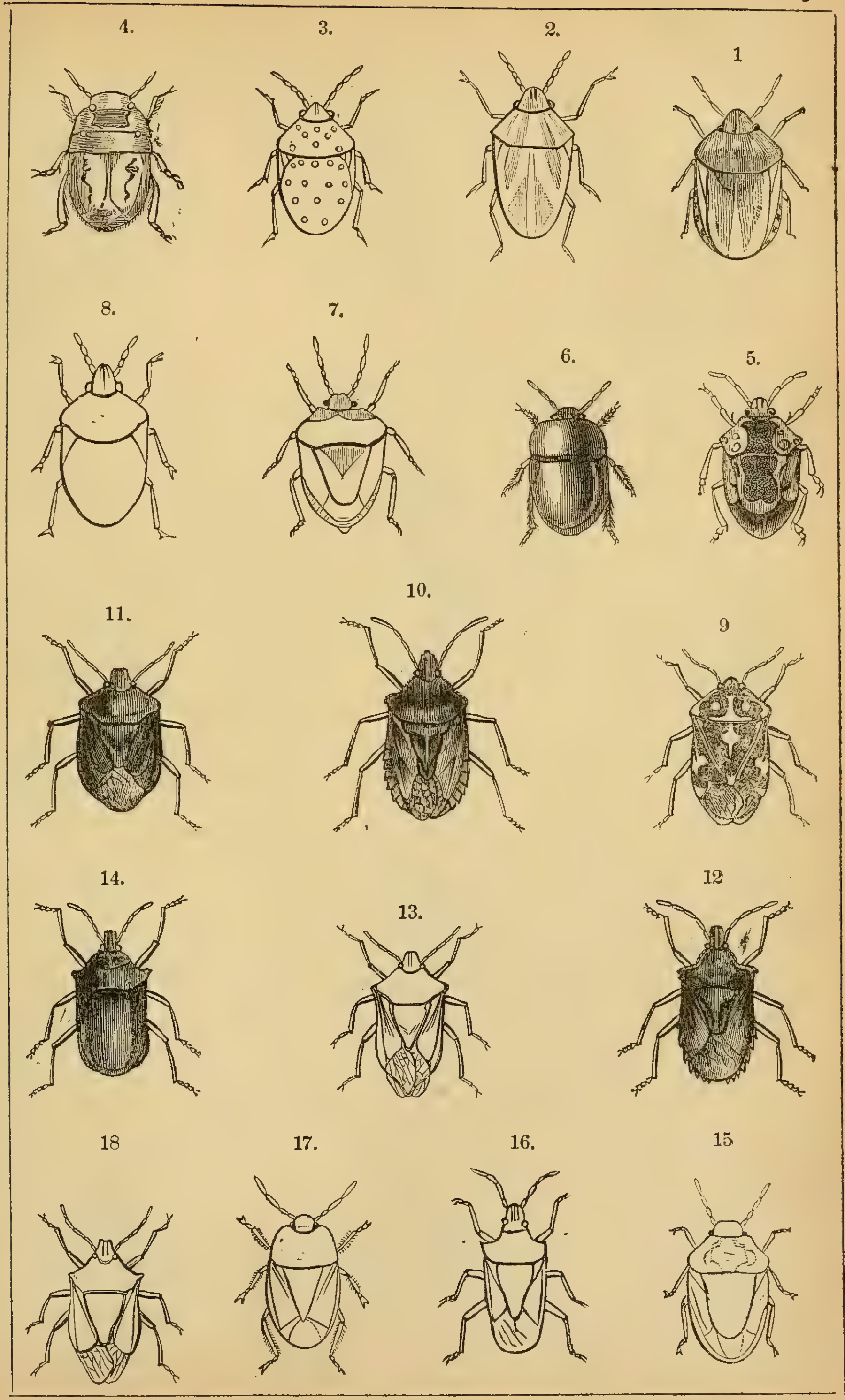
PLATE XX.

FIG. 19. Orectoderus amœnus, Uhler.
20. Conorhinus variegatus, Drury.
21. Phytocoris nubilus, Say.
22. Lygæus reclivatus, Say.
23. Acanthocephala femorata, Fab.
24. Lygæus pilosulus, H.-Schf.
25. Trigonotylus ruficornis, Fallen.
26. Mozena lineolata, H.-Schf.
27. Miris instabilis, Uhler.
28. Lygus annexus, Uhler.
29. Largus succinctus, Linn.
30. Calocoris Palmeri, Uhler.

PLATE XXI.

FIG. 31. Sinea diadema, Fab.
32. Ranatra 4-dentata, Stål.
33. Notonecta undulata, Say.
34. Galgulus oculatus, Fab.
35. Melanolestes picipes, H.-Schf.
36. Ambrysus Signoreti, Stål.
37. Monalocoris filicis, Linn.
38. Belostoma americana, Leidy.
39. Limnoporus rufoscutellatus, Lat.
40. Hygrotrechus remigis, Say.
41. Anthocoris musculus, Say.
42. Zaitha fluminea, Say.
43. Corixa alternata, Say.
44. Phymata erosa, Linn.

All of these figures are much enlarged, some of them twice to three times as large as the natural specimens.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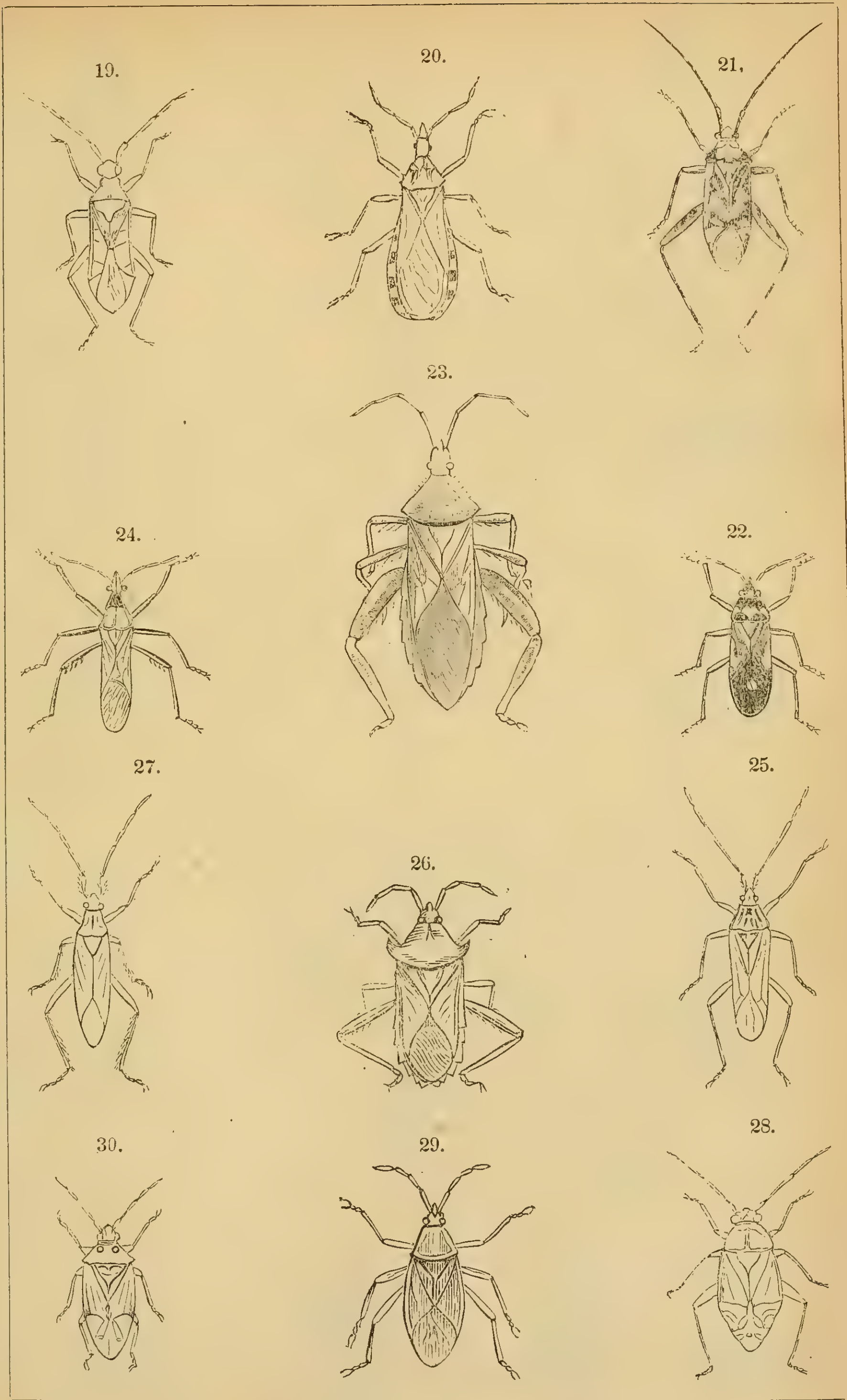
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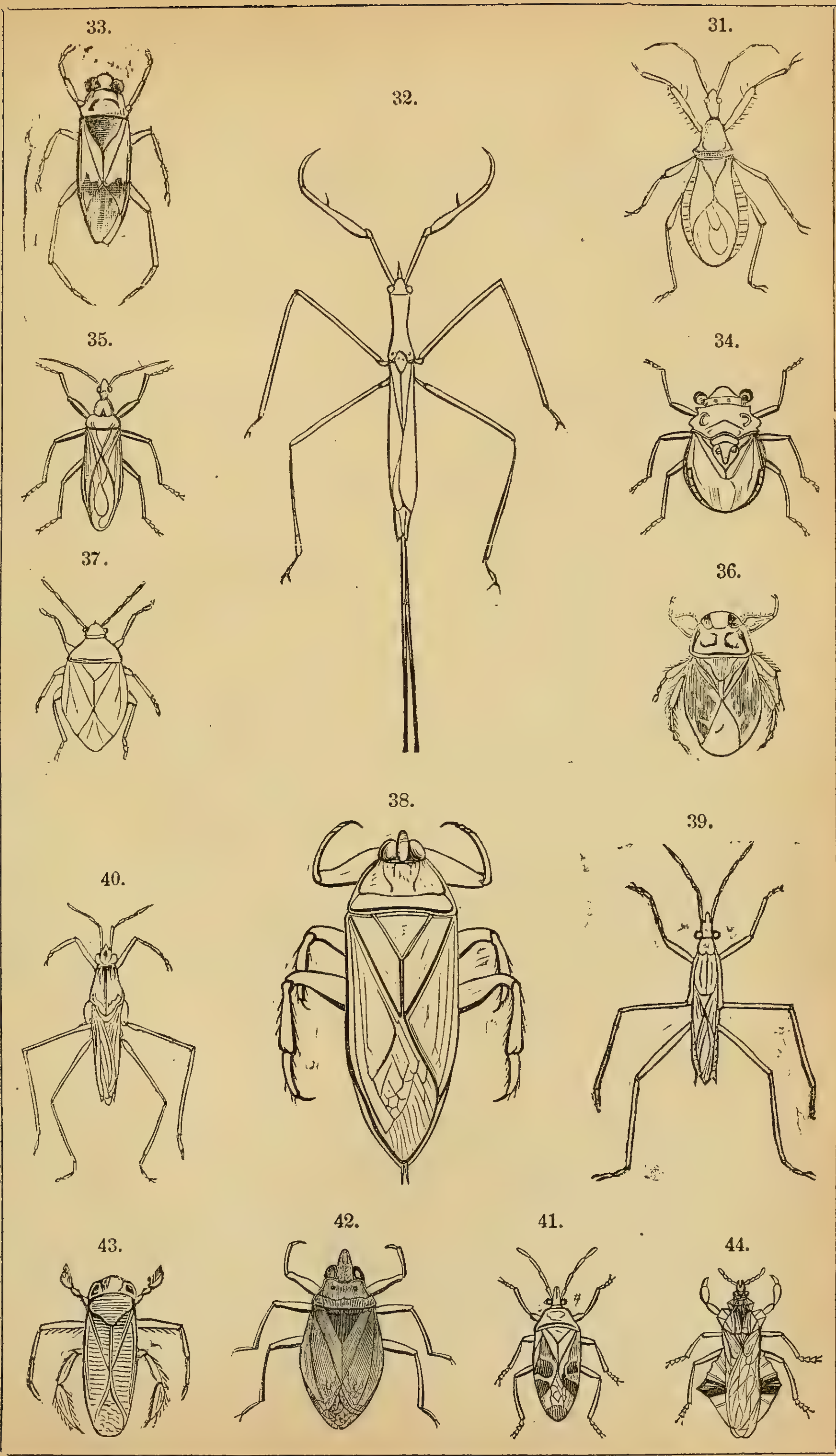
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ON SOME NEW SPECIES OF FOSSIL PLANTS FROM THE LIGNITIC FORMATIONS.

INTRODUCTION.

A considerable number of specimens have been lately delivered to me for examination by Prof. F. V. Hayden, who obtained them from clay and sandstone strata at or near Point of Rocks, a station of the Union Pacific Railroad between Black Butte and Salt Well stations, Wyoming Territory. From Professor Meek's reports, and from my own, it will be seen that from Black Butte to Point of Rocks, in following the railroad, the eastward dip of the measures brings successively in view a series of heavy sandstones interstratified with beds of clay and lignite, whose whole thickness, according to Messrs. Meek and Bannister, is estimated at 4,000 feet.* My own estimation gives only half this thickness. But as I did not take any measurements, the purpose of my explorations in that part of the country being essentially the research and study of vegetable remains, I readily admit the conclusions of those distinguished geologists who had time to attend to details of stratigraphy. At Point of Rocks, therefore, in following the base of the sandstone ridge from Black Butte station, we have passed such a heavy series of formations that, if any part of this so-called Bitter Creek series is Cretaceous, even Upper Cretaceous, we should expect to find in the fossil plants collected around this locality a number of species of Cretaceous types, or at least a great modification in the characters of the plants. The question will be more clearly examined and understood after the exposition of the specific characters of the vegetable remains which are described here below, and of the evidence of their relations. All these species from Point of Rocks have been already carefully figured from a large number of specimens, in five supplementary plates for the monography of the lignitic flora.

DESCRIPTION OF SPECIES FROM POINT OF ROCKS.

1. LEMNA? BULLATA, *sp. nov.*

Fronds? large, varying in diameter from one to three and a half centimeters, broadly obovate, or nearly round in outline, bordered from above the base and all around by a wavy margin four to five millimeters broad, generally gradually narrowed into a short pedicel about three millimeters thick, and terminating into a bundle of radicles.

This vegetable form represents a floating and somewhat bladdery plant; for, according to the plan of compression and of flattening, it is either quite round, with the base of the pedicel marked by a round knob in the center, or gradually narrowed to the pedicel where from the veins are emerging in two or three thick bundles, dividing at the base of the

* Dr. F. V. Hayden's Sixth Annual Report, for the year 1872, p. 533.

fronds, and forming in ascending, and by a kind of abnormal anastomosis, irregularly polygonal large meshes. The area of the inflated and central part is separated by a deep narrow groove from the flat margin which surrounds it, and whose areolation is disconnected and distinct, representing large quadrangular areolæ, whose subdivisions curve along the borders in festoons. Sometimes, however, the central part does not appear inflated; and sometimes, also, in specimens which seem to represent young plants, no trace of borders is perceivable. The radicles all equal in size, filiform, come out in bundles from divisions of short roots, or rhizomas, and form a thick coating wherein the plants were superposed or floating; for they appear often surrounded by these filaments or immersed into a matting of them. The point of connection of these rootlets to the fronds is rarely distinct. The only specimen where I could see it clearly is represented in one of the figures; and even this case is not conclusive evidence for all the fronds; for in some ones, the base of the fronds or of the pedicels seems attached to a kind of floating thallus. The upper surface of these plants is slightly rough; the central part, inside of the fringe, is somewhat thicker; and the lower surface is dotted with minute holes or apparently spongious.

One of the specimens seems to represent a fruit, or a different species of the same genus. The central nucleus is oval, three and a half centimeters long, two centimeters broad, somewhat tumescent, marked lengthwise by irregular striæ, or wrinkles, surrounded by a sinuate border six to eight millimeters broad, laterally wrinkled, narrowing downward to the point where it joins the short pedicel, which is one and a half centimeters long and two millimeters broad at its base. The central part of this fruit, or frond, is thicker and apparently more compact than in the other form, and the specimen which represents this variety, or species, is unique. No trace of nervation or areolation is discernible upon its surface.

I do not know as yet to what family of plants these peculiar organisms are referable. In the Geological Report of Prof. G. M. Dawson in the Vicinity of the Forty-ninth Parallel, Prof. J. W. Dawson has described and figured (in appendix, p. 329, Pl. XVI, figs. 5–6), under the name of *Lemna scutata*, a plant which appears to be the same as ours, or which is, at least, very closely allied to it. The characters, however, do not agree with those of *Lemna*. The rootlets marked at the base of the circular fronds seem to prove that these organs were like vesicles, or were inflated, like those of our plate; for, if they had been flattened upon the surface of the water like *Lemna* fronds, the rootlets would not appear on one side of the frond or at its base. This species is represented by more than fifty specimens.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

2. FUCUS LIGNITUM, *sp. nov.*

Frond flattened, irregularly dichotomous; branches diverging obliquely; branchlets short, terminal, linear-divaricate, tufted, forking at the point.

The fragment figured is the only one of this kind in the specimens. It represents a species allied to *Sphærococcus crispiformis*, Sternb., as described in Heer's Flor. Tert. Helv. (p. 23, Pl. IV, fig. 1), and still more, perhaps, to the living *Fucus canaliculatus*, Agh., very common along the coasts of the Baltic Sea, and also discovered in numerous specimens in the Tertiary of Spitzbergen. The base of the lowest branches is four millimeters broad, but the size of the branchlets diminishes nearly one-half at each dichotomous division. The terminal branchlets are only half a millimeter broad, fasciculate-dichotomous, short, split, or furcate at the

point, and divaricate. The substance appears thin, membranaceous, and yellowish.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

3. SELAGINELLA ? FALCATA, *sp. nov.*

Frond small, dichotomous; pinnæ narrow-linear, one to four centimeters long, six to seven millimeters broad; pinnules close, two-ranked, in right angle to the rachis, generally covering each other at the borders, falcate upwards, lanceolate-acuminate, suddenly narrowed to the point of attachment, without distinct middle nerve.

I have figured four different parts of this plant, which is abundantly scattered among the floating rootlets and upon the specimens of the *Lemna*? described above. It may represent some kind of floating fern perhaps, rather than a species of *Selaginella*. It is, however, closely allied to *Selaginella Berthoudi*, Lsqx., described in Dr. Hayden's Annual Report for 1873 (p. 395), differing, however, by the two-ranked position of the leaves and their distinctly falcate form.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

4. SEQUOIA BREVIFOLIA, Heer.

Branches flexuous; branchlets opposite or alternate, open and diverging near the base, then curving upward and erect from the middle to the top. Leaves of two kinds, either small, short, scaliform at the base of the branchlets and covering the whole of them when young, or oblong, enlarged in the middle, obtuse or abruptly narrowed to a point, and gradually and slightly so toward the decurring base, distichous, oblique, decreasing in length toward the base and the top of the branchlets. We have a large branch* and numerous more fragmentary specimens of this fine species described by Heer in Flor. Arct. (p. 93, Pl. II, fig. 23), from Greenland specimens, in Flor. Spitz. (p. 37, Pl. IV, figs. 2–3), from Spitzbergen specimens, and formerly in Fl. Baltica (p. 21, Pl. III, fig. 10.) It is well characterized by the form of its generally short open distichous leaves, either abruptly pointed, or obtuse, deeply nerved, and slightly decreasing in width from above the middle to the base. We have, however, a number of specimens with somewhat narrower, nearly linear, longer leaves, which show a notable deviation of the normal form. The cone of this species is not known as yet. One of the specimens bearing scattered branchlets and leaves of this *Sequoia* has a cone, which appears to be a flattened cross-section, or perhaps the flattened base of the cone turned upward, the pedicel marking the central point around which the scales, oblong, cuneate narrow emarginate at the top, are imbricated to the borders. These scales rather resemble those of a *Glyptostrobus* than those of a *Sequoia*.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

5. SEQUOIA LONGIFOLIA, Lsqx., MSS.

Branches thick; leaves closely appressed, erect, long linear lanceolate-pointed or accuminate, enlarged above the slightly contracted and decurring base; scars deep, lingulate-pointed, marked by a deep groove in the middle.

This species was already described from Black Butte specimens; these have, some of them at least, leaves longer than those of Black Butte. In these, the leaves average two and a half to three centimeters long and three millimeters wide; in those of Point of Rocks, the leaves, of the same

* A beautiful specimen, the property of Mr. E. H. Clarke, agent of the Union Pacific Railroad, who kindly lent it for illustration of the species.

width, are generally five centimeters long, even more. In both forms, they are marked by a broad indistinct middle nerve, and the surface, seen with the glass, appears very thinly striated in the length. This character, as well as the thick consistence of the leaves, seems to prove the identity of the species, though the leaves of the specimens of Point of Rocks are not only longer but proportionally narrower and scarcely contracted to the point of attachment to the branches. In both, these leaves are generally crowded and covering the stem.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

6. SEQUOIA BIFORMIS, *sp. nov.*

Stems thick, pinnately branching; branchlets short, obliquely diverging; leaves either linear or somewhat broader in the middle, gradually narrowed to a point, slightly contracted to the decurrent base, slightly incurved or falcate, sometimes erect and appressed to the stem; scar-leaves triangular or lingulate-pointed.

This species apparently bears two kinds of leaves, even upon the same specimens; either long, two centimeters, and very narrow-linear, less than one millimeter wide, or shorter and broader, decreasing gradually from the base to the point, linear-lanceolate, nearly one and one-half millimeters wide and only eight to ten millimeters long; the middle nerve is deeply marked upon both kinds of leaves. I should have considered the numerous specimens bearing branches of this *Sequoia* as representing two species, the one with narrow longer leaves, the other with shorter broader leaves. But even the difference in the length and proportionate width of the leaves is distinctly perceivable upon one of the specimens, and the difference also in the length of the leaves, all narrow and of the same width, is evident upon another. There are, moreover, a large number of specimens, all fragmentary indeed; and the difference in regard to the size of the leaves is apparent upon most of them. In the average, the leaves are much narrower than those of *Sequoia Reichenbachi*, Heer, to which this species is related by the falcate form of some of the leaves.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

7. WIDDRINGTONIA COMPLANATA, *sp. nov.*

Stem thick, disticho-pinnate; branchlets short, thick, alternate, oblique; leaves small, in spiral order, closely imbricate and appressed, oblong-lingulate pointed upon the primary branches, ovate-pointed or rhomboidal and shorter upon the obtuse branchlets.

This species, represented by many specimens, is evidently related to *Widdringtonia antiqua* (Sap. Et., 2, 1, p. 69, Pl. I, fig. 4), for the form of the leaves, which are, however, more closely appressed in the American species, and more distinctly placed in spiral order around the branchlets. These leaves do not appear of a thick substance, the coat of coaly matter over them being extremely thin.

8. FICUS ASARIFOLIA, Ett.

Leaves petioled, broadly reniform, subcordate or subpeltate, very obtuse, small, with borders crenulate; primary nerves palmately five to seven; middle nerve straight; upper lateral ones strong, curving inward, branching and anastomosing with the upper secondary veins; veinlets transversal, their ramification forming a protuberant, or embossed, very distinct, polygonal areolation.

Though this species has been already briefly described from specimens found at Golden, in Dr. F. V. Hayden's Report for 1872 (p. 378), it had as yet not been figured, the fragments of leaves being generally

too incomplete. It is, however, easily recognized by its peculiar nervation, forming small, elevated, polygonal areolæ, an areolation like an embossed checker-board, resembling that of *Asarum Europeum.* The fragments of Golden seem to be part of much larger leaves than those of Ettinghausen, who described the species in Bilin Flora (p. 80, Pl. XXV, figs. 2–3). These *per contra*, from specimens of Point of Rocks, are perfectly well and entirely preserved leaves, rather smaller, except one, than the leaves of Bilin. They are also slightly more expanded on the sides, or reniform, and the crenulations less distinct; but these border-divisions are, for their size, related to the areolation, which is wider in proportion of the size of the leaves. Our leaves, also, are evidently peltate, at least in two of the figured specimens. One only has the position of the thick petiole marked similarly to that of the European leaves; but even the representation of the species by the author seems to indicate peltate leaves, whose borders are erased at the base or at the point of attachment of the petiole. The differences are too unimportant to be considered as specific characters. These leaves merely represent a local variety, or a *var. minor.* This species appears to be rare in the Tertiary of Europe, as it has till now been seen only in the plastic clay-beds of Bilin.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

9. FICUS DALMATICA, Ett.

Leaves narrowly ovate, obtusely pointed, narrowed to a short petiole; middle nerve thick toward the base, thinning upward; basilar lateral nerves from above the border-base of the leaves, thin, ascending at an acute angle of divergence of thirty degrees, to the middle of the leaf; secondary veins more open, equidistant; nervation camptodrome, joined by transverse nervilles.

In considering the figure of the author in Flora Promina (Pl. VII, fig. 11), there is no difference whatever between the European form and ours; but the description says that the secondary veins are branching at the point, and there is no trace of divisions of veins observable upon our specimens. As, however, the figured single leaf shows merely transverse nervilles and not real branches, and as these nervilles are also visible on the American form, it is evidently identical. One of the leaves represented in our plate seems rounded. This is caused by its reversement into the stone; the upper part of the leaf being flat and the lower curved down in entering the stone, where the extreme base and petiole are imbedded.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

10. DIOSPYROS BRACHYSEPALA, Al. Braun.

This species has been described already in Dr. Hayden's Report for 1872 (p. 394) from specimens of Black Butte, and in Report for 1873 (p. 401) from specimens of Sand Creek, Colorado, a locality identified with Golden by its flora. But none of the leaves found as yet is as well preserved and as well characterized as that of Point of Rocks, which is especially comparable to the leaves in Heer's Fl. Tert. Helv. (Pl. CII, fig. 2). The species is not rare in the Miocene of Europe, especially in the lower groups, and appears equally widely distributed in our Lower Tertiary.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

11. FICUS TILIÆFOLIA, Heer.

Like the former, it has been described previously in Dr. F. V. Hayden's Report for 1871: p. 287, from specimens of Washakie station mentioned in supplement to this report, p. 12, from Evanston; p. 6,

from Placière anthracite; in same report, for 1872, p. 375, from above the Gehrung's coal, near Colorado City; and p. 393, from Black Butte station. We have also specimens from Golden and other localities; for here, as in the Miocene of Europe, this fine species, so easily identified, is distributed through the whole thickness of the Lignitic, excepting, however, the upper stage, that of the Green River group, where it has not been found as yet. I have figured it from specimens of Point of Rocks, not merely because it is there clearly represented, but to show more evidently the relation of this locality with the Tertiary Lignitic.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

12. FICUS IRREGULARIS, Lsqx.

This species was published under the name of *Ulmus ? irregularis*, in Dr. F. V. Hayden's Report for 1872 (p. 378), the generic reference being then uncertain. Numerous specimens obtained later from Black Butte, where the species is common, shows a thick inflated leaf-stalk, a character which indicates the relation to *Ficus*. The specimen of Point of Rock is like the counterpart of one already engraved from Black Butte specimens; the identity of characters is unmistakable, and therefore it was figured also as another record of identity of the flora of both localities.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

13. LAURUS (PERSEA) PRÆSTANS ?, *sp. nov.*

Leaf coriaceous, large, broadly lanceolate or elliptical, narrowed upward to an acute point, and downward in the same degree to a thick, short petiole; middle nerve thick; secondary veins strong, parallel; nervilles distinct; areolation very small, lightly marked.

The very fine and well-preserved leaf is sixteen centimeters long from the base of the thick petiole, which is one centimeter long, five centimeters broad in the middle, where it is the widest, and has thick secondary veins regularly branching, with distinct nervilles and the areolation of a *Laurus*. The foliaceous substance of the lower part of the leaf is destroyed, but the middle thick nerve and the petiole are preserved, as well as the outline-borders. By its nervation, this species is allied to *Persea speciosa*, Heer, differing by the form of the leaf and the thick middle nerve. By these two last characters, it is comparable to *Laurus princeps*, Heer (Fl. Tert. Helv., II, p. 77, Pl. XC, figs. 17–20), differing, however, by the secondary veins somewhat thicker and slightly more distant. It is most closely related to the present *Laurus Canariensis*, Sm.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

14. VIBURNUM ROTUNDIFOLIUM, *sp. nov.*

Leaf nearly round, small, surrounded by a black border, slightly and distantly denticulate by extension of the borders at the point of contact of the secondary veins and of their branches, all craspedodrome; secondary veins open, diverging fifty to sixty degrees, equidistant, parallel, the two lower pairs ramified, the upper ones only forking near the borders; areolation distinct, from parallel distant fibrillæ, branching and anastomosing in large equilateral meshes

The black borders of the leaves, the general characters of nervation, and the facies are the same as in the other species of *Viburnum* published from Black Butte. This leaf differs especially by its nearly round form, the base rounded to the petiole, the secondary veins more open, and especially the very small, slightly-marked teeth of the borders. But for this last character, this leaf could be referred to *Viburnum platanoides*, Lsqx., as represented by the small leaf of Pl. XXXVIII, fig. 10, of the

ined. Lignitic Flora. In this, the secondary veins are, however, more oblique and more distant. It may be a mere local variety.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

15. VIBURNUM WYMPERI, Heer.

This species has been described in Dr. F. V. Hayden's report for 1873, p. 382, and referred, with some doubt, to the Greenland species described in Arct. Flor. (II, p. 475, Pl. XLVI, fig. 1b). The secondary veins in our species are more distant and less regularly parallel. Though it may be of its relation to the arctic species, the leaf of Point of Rocks does not show any difference whatever from that of Black Butte.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

16. TRAPA? MICROPHYLLA, *sp. nov.*

Leaves small, round, or broadly oval, obtuse, rounded to a short petiole, with borders denticulate from below the middle, three-nerved from the top of the petiole, or irregularly pinnately nerved; lateral veins at an acute angle of divergence, fifteen to twenty degrees, flexuous, with dichotomous branches, all craspedodrome; areolation by subdivision at right angle, polygonal, distinct.

These leaves vary in size from a little more than one centimeter long and nearly as broad to about two and a half centimeters long and nearly two centimeters broad. They are generally oval-obtuse, somewhat enlarged toward the round point; the borders are minutely dentate except at and near the base, rounded to a comparatively long and slender petiole, the only one of the leaves where it is preserved being eighteen millimeters long, and its petiole nine millimeters. The areolation is peculiar, in square or polygonal areolæ, formed by close, thick nervilles, anastomosing with veinlets parallel to the veins and their divisions, the areolation being clearly defined, and the parietes as thick as the veins. The same kind of areolation is remarked upon the lower surface of the leaves of *Trapa natans*, which, though comparable to the fossil ones by the areolation, has its borders deeply toothed and a much thicker consistence. In this species, the leaves appear membranaceous and as pellucid, so distinctly marked in black appear the nervation and the areolation upon the yellowish substance of the leaves. These leaves are mixed with the filaments or rootlets described with *Lemna? bullata*, and represent evidently a kind of water-plant. No fossil leaves published as yet are, to my knowledge, comparable to these, except those described by Professor Newberry, in the Report of the Colorado Exploring Expedition by Lieut. S. C. Ives (p. 131, Pl. III, fig. 5), under the name of *Neuropteris angulata*. The outline or general form of the slightly dentate leaves, the pinnate nervation, and the remarkably acute angle of the secondary veins are characters common to both species; even the irregular though too obscurely marked division of the secondary veins seem to be of the same kind. It may be remarked that Professor Dawson has observed and described a fruit of *Trapa* found in connection with his *Lemna scutata;* therefore, in circumstances similar to those where these leaves referred to, *Trapa* are found.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

17. RHUS MEMBRANACEA, *sp. nov.*

Leaves small, membranaceous, thickish, oblong, obtusely-pointed, rounded or subtruncate at base, irregularly coarsely duplicato-dentate; lateral veins open, the lowest decurving to the middle nerve, craspedodrome, more or less ramified.

Of this species, there is the point of a leaf, and another one nearly

entire, though somewhat lacerated, about two and a half centimeters long, including the petiole (three millimeters), and one and a half centimeters broad, oblong or lingulate, with borders cut from the base in comparatively large, pointed teeth, either simple or with small protuberances on the back of the largest ones; nervation craspedodrome, the secondary veins entering the large teeth, and more or less irregularly and obscurely dividing in very thin branches, joined in the middle, and forming a large, scarcely distinct areolation. By the form of the leaves and the border-divisions, this species is comparable and closely related to *Rhus Pyrrhæ*, Ung., as figured in Tert. Flor. Helv. of Heer (Pl. CXXVI, fig. 20), which has leaves, round truncate at the base, and short-petioled, as in one of our specimens. Like *Rhus Pyrrhæ*, it is also comparable to *Rhus aromatica*, Ait., a very common species of our present flora. This has also generally doubly dentate teeth, and, in southern specimens, a thickish, membranaceous consistence.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

18. JUGLANS RHAMNOIDES, Lsqx.

A small leaf of this species, which is not yet, however, definitively limited, as seen from the description in Dr. F. V. Hayden's Report for 1871 (p. 294), and which may be identical with *Juglans Leconteana*, Lsqx., and *Cornus acuminata*, Newby. Though it may be of the value of the species, the leaf from Point of Rocks is identical in all its characters, even in its size, with some of those found in the burned beds of red shales at Black Butte.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

19. POPULUS MELANARIA, Heer.

Leaves with a long, slender petiole; deltoid, subtruncate at base; borders acutely serrate; primary basilar lateral nerves emerging from above the border-base of the leaf, with a pair of thin marginal veinlets underneath.

Considering what can be seen of this leaf from the fragment which represents merely its lower half, with the long, slender petiole, the distinct nervation, and a few of the border-teeth, it exhibits characters in accordance with those described above, and translated from Schimper's Vegetable Paleontology, and especially with the figure given of this species in Flor. Tert. Helv. (Pl. LIV, fig. 7). Professor Heer remarks, that it essentially differs from *Populus latior*, var. *subtruncata*, by the position of the lateral primary nerves at a distance from the border-base of the leaves. In the leaf figured as indicated above, this distance is still greater than in that of the Flor. Helv. Heer remarks also that he has seen a large number of specimens of the same species, but that in all except one, which he has figured, the upper part of the leaves was destroyed, as it is in ours. He mentions as distinctive characters, the acutely serrate borders of the leaves, and the middle nerve thicker than the lateral ones, the same as seen upon our specimen. I have, therefore, no doubt about the relation of this leaf to the European species.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

20. QUERCUS COMPETENS, *sp. nov.*

Leaf oval, equally narrowed to the obtuse point and to the base, irregularly and obtusely dentate; secondary veins distant, parallel, at an acute angle of divergence.

This leaf, unsatisfactorily preserved, is comparable to many species of

fossil and living oaks, but has not any decided relation to any one. Allied to *Quercus Meriani*, Heer, *Q. Nimrodi*, Ung., by the general form of the leaves and the divisions of the borders, it differs from them by the nervation. The same differences are remarked in comparing it to *Quercus triangularis*, Göpp.; and from *Quercus attenuata*, Göpp., which has the same kind of nervation, it positively differs by the large obtuse teeth of the borders.

HABITAT.—Point of Rocks, *Dr. F. V. Hayden.*

21. DRYOPHYLLUM CRENATUM, *sp. nov.*

Leaves oblong-lanceolate, broadly cuneate or subtruncate to the base, regularly, deeply crenate; nervation pinnate; middle nerve flat; secondary veins distant, thick, open, diverging sixty to sixty-five degrees, slightly curving, subcamptodrome; substance of the leaves thick; surface rough.

This species is represented only by two fragmentary specimens, both figured, and exemplifying the nervation and reticulation. The form of the leaves is not positively defined by these fragments. It appears oblong, lanceolate upward, and truncate or broadly wedge-form at base The borders are obtusely dentate or broadly sinuate-crenate, and, as it is the case in the representative of this genus, the secondary veins are half camptodrome, or forking, before entering the teeth; one of the divisions passing along the borders, while a branch goes up into the teeth. This species is a representative of a subdivision of the *Quercineæ*, or *Quercus* species, which is widely represented in the Cretaceous of Europe, or, at least, of Belgium, according to the information of Messrs. Devey and Ettinghausen, though none has as yet been published. We have it in our Cretaceous of Nebraska in one fine species, *Quercus primordialis*, Lsqx.; and as it persists in the Lower Tertiary of Europe, where it is represented by four species in the flora of the Lowest Eocene of Belgium, the *Marnes Heersiennes* of Gelinden, and by four species also in the Eocene of Sezanc, inferior to the Mount Bolca stage, we cannot be surprised to find it also in our Lower American Tertiary. Another species, *Quercus furcinervis*, Rossm., has been identified in the Lignitic strata of Golden, though in fragmentary specimens, and in very good and numerous ones under the conglomerate and lava deposits of the Cascade Mountains of Oregon. In the integrity of its typical character, this group of oaks may be considered as originating in the Cretaceous, as fully developed in the Eocene, passing through the Miocene by derived types, *Quercus lonchitis*, *Q. Drymeja*, and represented in our flora by the predominant group of the chestnut-oaks.

HABITAT.—Point of Rocks, *F. V. Hayden.*

Besides the above described and figured species, the specimens obtained from Point of Rocks by Dr. Hayden have still one leaf of *Ficus planicostata*, Lsqx., a species very common at Black Butte. This leaf is deformed by compression of the clay wherein it is embedded, one side of it being deeply wrinkled and lacerated, while the other had one of the primary lateral veins and its divisions distinct. The broad, flat nerve, and the areolation of that part of leaf, are sufficient for identification. Some other specimens, also, represent rhizomas, stems, and grass-like leaves, whose reference is still somewhat uncertain. They seem by their form, their nervation, and an indistinct articulation, referable to a species of *Arundo*, like *A. Goepperti*. And then, also, the family of the Palm is represented there by five specimens, bearing fragments of leaves of *Sabal Grayana*, identified by its distinct and peculiar nervation. The double rays vary in width from one and a half to four centimeters.

ON THE EVIDENCE AFFORDED BY THE FOSSIL PLANTS OF POINT OF ROCKS IN REGARD TO THE GEOLOGICAL AGE OF THE FORMATION.

Before pursuing the description of the species recognized from specimens obtained from localities others than Point of Rocks since the publication of the last annual report of Dr. F. V. Hayden (1873), it is advisable to consider the characters of the group of plants described above in relation to its geological affinity.

The first of the species described, *Lemna ? bullata*,* is, to my belief, identical with what has been published by Professor Dawson under the name of *Lemna scutata*, as remarked in the description of the species; for probably the first description was made from a small number of more imperfect specimens than those which I have at my disposal. Though we have one single kind of vegetable organism as proving the relation of the strata where the remains have been found, they are of such a peculiar character and unique form that we may admit their relation as proved.† Now, the species enumerated and described in the Canada report are representatives of two groups, separated as the Porcupine Creek group, including Souris River, and the Great Valley or Pyramid Creek group, both positively recognized as of Tertiary age by stratigraphy and lithology in the remarkably clear and instructive report of Prof. George Mercer Dawson. He describes (p. 86) the first exposures of the Tertiary, overlying the Cretaceous of the Pembina Valley, as consisting of hard beds of sandstone, which form the base of the Lignite Tertiary. One of his sections (illustrated in Pl. III, fig. 2, of the report, and described in p. 89), shows very perfectly the distribution of the strata in some localities of those Lignitic formations of Canada, and is especially remarkable for the great number of its beds of lignite, seven in number, averaging altogether seventeen feet six inches of coal in a section of fifty-seven feet seven inches of measures. The section is as follows:

		Ft.	In.
1.	Prairie sod—mixed shale and drift	7	0
2.	Lignite	6	6
3.	Grayish sandy shale (about)	4	0
4.	Lignite	1	6
5.	Grayish and yellowish well-stratified clays	14	0
6.	Nodular iron-stone	0	4
7.	Grayish and whitish clay	2	0
8.	Carbonaceous shale	1	0
9.	Gray soft sandstone	1	8
10.	Lignite	1	0
11.	Gray and yellowish laminated sandy clay	5	0
12.	Iron-stone (nodular)	0	3
13.	Lignite	1	7
14.	Carbonaceous shale	1	6
15.	Lignite	2	2
16.	Gray sandy clay	2	0
17.	Lignite	1	5
18.	Sandy under clay, with large and small roots, badly preserved	1	6
19.	Lignite	3	2
20.	Grayish sandy clay	..	..
		57	7

* The specific name is changed in consideration of the vascular form of most of the specimens. The generic relation has to be modified also when it is more clearly recognized.

† Another species, enumerated by Professor Dawson, *Cornus acuminata*, Newby., as present in the Tertiary of Canada, is also found at Black Butte.

In the second group, as remarked by the author of the report, p. 93, the beds exposed to view are at an elevation of about seven hundred feet greater than those of the Souris River; their exact relation, however, being statigraphically undeterminable. A section in the Great Valley (completed p. 94) mostly represents clay beds and thin lignite beds with remains of plants. In one hundred and forty-four feet of measures, there is only one bed of lignite one foot thick; while at Porcupine Creek, or in a valley joining it, a section of forty feet (represented in Pl. V, fig. 1) shows a fine display of lignite beds, as follows:

	Ft.	In.
1. Surface soil	1	0
2. Quartzite drift	1	6
3. Yellowish and gray sandy clays	9	0
4. Lignite	0	9
5. Banded clays, yellowish-gray, &c., with plants	5	0
6. Lignite, weathering, soft	10	0
7. Lignite, hard, compact, laminated	8	0
8. Soft gray sandstone	5	0

More details in regard to these sections of the Lignitic are unnecessary to prove the relation of these Canadian Lignitic measures with those of the North. The succession of the strata is variable, and may differ at each locality; they however represent the same formation as our great Lignitic of the West, and the determination of their age as Tertiary is forcible for the North American Lignitic as well as for that of Canada in considering the whole as a unique formation.

In the examination of the fossil plants which he had to determine, Prof. J. W. Dawson first remarks: "That the plants of the first group are for the most part identical with those found by American geologists in the Fort Union series, and which have been determined by Professor Newberry and Mr. Lesquereux. They are also similar to plants collected by Dr. Richardson in the Lignitic series of the Mackenzie River, as described by Heer, and represented by specimens in the collection of the geological survey, etc. They also approach very closely the so-called Miocene floras of Alaska and Greenland, as described by Heer; and, in their facies and in several of their species, they coincide with the Miocene flora of Europe." He then adds: "If we were to regard the affinities of the plants merely, and to compare them with the Miocene of other countries, and also to consider the fact that several of the species are identical with those still living, and that the whole facies of the flora coincides with that of modern temperate America, little hesitation would be felt in assigning the formation in which they occur to the Miocene period. On the other hand, when we consider the fact that the lower beds of this formation hold the remains of reptiles of Mesozoic types; that the beds pass downward into rocks holding *Baculites* and *Inocerami*; and that a flora essentially similar is found associated with Cretaceous marine-animal remains both in Dakota* and in Vancouver's Island, we should be inclined to assign them at least to the base of Eocene."

From the above we see that Professor Dawson positively acknowledges, as the result of his study of the fossil plants of the Lignitic, the Tertiary age of these formations. He briefly describes or enumerates from Porcupine Creek seventeen species, all of Tertiary types, and most of them described formerly by Professor Heer and Professor New-

*This is right for the flora of Vancouver's Island, but not for that of the Dakota group. The assertion, however, does not weaken the truth of the conclusion.

berry from the so-called Miocene formations of Alaska, Greenland, and especially of the Fort Union group, with which the group of Porcupine Creek appears very closely allied. From the group of the Great Valley, he has three species: *Equisetum Parlatorii*, Heer, of the Miocene of Europe, to which our *Equisetum Haydenii* of Carbon is closely related; *Salix Rheana*, Heer, of the Greenland Tertiary flora; and a species of *Rhamnus;* from the formation of the Bad Lands: *Lemna scutata*, a new species which I consider as identical with that represented by very abundant remains at Point of Rocks; *Sapindus affinis*, Newb., of the Union group; and some remains not precisely determined, referable to *Scirpus* and fruits. In all this flora there is no trace of any vegetable remains which, by comparison with the species of the Dakota group or with those of the Cretaceous of Europe, could be recognized as identical with, or even related to any of them.

How is it now with the species found associated at Point of Rocks with that peculiar floating vesicular plant provisionally named *Lemna bullata?* The second species described after this *Lemna* is a *Fucus*, comparable to two species, one described from the Miocene of Europe, the other still living in the Baltic Sea. This is also found in a fossil state in the Tertiary of Spitzbergen. The third is apparently a *Selaginella.* The only fossil plant to which this has any likeness is *Selaginella Berthoudi* of Golden. The affinity of these two species is the more conclusive as no lycopodiaceous plant has been described till now, either from the Cretaceous or from the Tertiary of any country but from the American Lignitic.

The preponderance of Conifers is as marked in the group of Point of Rocks as the total absence of Ferns. On this point, it is in the inverse ratio of the flora of Golden, where no remains of Conifers have been found as yet, but where the Ferns abound. The flora of Black Butte is on this point intermediate, having in equal proportion species of Ferns and of Conifers. Among the species of this last family described from Point of Rocks, one, *Sequoia longifolia*, is found also at Black Butte; another, represented by a large number of fine specimens, *Sequoia brevifolia*, is in the Miocene of Greenland, of Spitzbergen, and of the Baltic; a third, *Sequoia biformis*, has not as yet been recognized elsewhere. It is, however, related to *Sequoia Sternbergii*, of the Lower Tertiary (Oligocene) of Europe, found at Hæring, especially at Promina, and recently in the Tertiary of New Mexico. Its analogy with *Sequoia Reichenbachi* has also been noticed in the description. The fourth species, *Widdringtonia complanata*, is a close relation of *W. antiqua*, of the same Oligocene formation of France.

In the division of the dicotyledonous plants we find: *Ficus asarifolia* of the Bilin Oligocene flora, formerly described from specimens from Golden; *Diospyros brachysepala*, common in the whole thickness of the Miocene and Oligocene of Europe, found in the Tertiary of Greenland also, and already described from Black Butte and Sand Creek; *Ficus tiliæfolia*, one of the most common species of the European Miocene, and not less abundantly represented in the whole thickness of the American Lignitic; *Viburnum Wymperi*, a rare Tertiary species, described from Greenland, Spitzbergen, and Black Butte. As belonging to the Miocene or Oligocene of Europe, and not found before in our Lignitic, Point of Rocks has: *Ficus Dalmatica*, known from Promina, the lowest stage of the Oligocene; *Laurus præstans* and *Populus melanaria*, both Lower Miocene types. As species identical with those of other American localities, but not known from Europe, we find still at Point of Rocks: *Ficus planicostata*, *Ficus irregularis*, *Juglans Rhamnoides*, all from Black Butte,

with *Viburnum rotundifolium* closely allied to *V. platanoides* of the same locality. The remains of *Sabal Grayana*, too, refer Point of Rocks by identity of species to Vancouver's Island, the Mississippi Tertiary, and Golden. We may mention still as new, species less important in regard to their local references: *Quercus competens*, seemingly allied to different Miocene species of Europe, though not identifiable with any; *Rhus membranacea*, comparable to our present *Rhus aromatica*, and also to the European *Rhus Pyrrhœ* of the Miocene; that peculiar species *Trapa microphylla*, found mixed with rootlets of water-plants, and whose relation cannot be recognized with any fossil species except *Neuropteris angulata;* and *Dryophyllum crenatum*, representative of a group or of a genus which has a large number of as yet undescribed forms in the Cretaceous of Belgium. Of this genus, however, we know already three species from the Cretaceous of this country and eight species from the Lower Eocene of Europe. These are the data from which we have to derive our conclusions in regard to the age of the Point of Rock formations. To do it more clearly, I give here, as a *résumé*, the table of the species described from this locality, with indication of their relations, as far as they are known.

Point of Rocks.	Canadian Tertiary.	European Miocene.	Arctic Miocene.	Golden.	Black Butte.	Cretaceous.
1. Lemna bullata	Id*					
2. Fucus lignitum		An	An			
3. Selaginella falcata				An		
4. Sabal Grayana				Id	Id	Vancouver.
5. Sequoia brevifolia		Id	Id			
6. Sequoia longifolia					Id	
7. Sequoia biformis						An
8. Widdringtonia complanata		An				
9. Ficus asarifolia		Id				
10. Ficus Dalmatica		Id				
11. Ficus planicostata					Id	
12. Ficus tiliæfolia		Id		Id	Id	
13. Ficus irregularis					Id	
14. Viburnum rotundifolium					An	
15. Viburnum Wymperi		Id			Id	
16. Diospyros brachysepala		Id		Id	Id	
17. Laurus præstans		An				
18. Trapa microphylla						An
19. Rhus membranacea		An				
20. Juglans rhamnoides	Id				Id	
21. Populus melanaria		Id				
22. Quercus competens		An				
23. Dryophyllum crenatum						An

* "Id." for identical; "an." for analogous.

This table shows that, of these twenty-three species, two are identical with Canadian species recognized as Tertiary, as seen in the quotations given above from the geological report of Prof. G. Dawson; seven are identical with, and five related to, species of the Lower European Miocene; two identified with the Arctic formations considered Miocene; three identified with, and one allied to, species of Golden; eight identified with, and one allied to, species of Black Butte; and two which have some analogy with Cretaceous types.

For this last remark I take the broadest range of probability of relationship, for we do not know any Cretaceous *Dryophyllum* from Europe, except *D. cretaceum*, published by Saporta in his Gelinden Flora, for a point of comparison for the species of this Lowest Eocene locality; and the identity of *Trapa microphylla* with the leaves published as *Neuropteris angulata* is not positively ascertained. I will add still that

Sequoia biformis has a distant relation to *Sequoia Reichenbachi*, one of the most widely distributed species of the Cretaceous formations. We should, therefore, in considering the above table, recognize the relation of the Point of Rocks' flora with the European and the American Tertiary (counting Black Butte and Golden as Tertiary), as marked by twenty species in twenty-three, or 87 per cent., while that to the Cretaceous is only indicated by three species, or 13 per cent. We have thus to recognize that Point of Rocks still belongs to the Lignitic Tertiary by its flora, though we discover in it traces of its approach to the Cretaceous.

This conclusion is in exact concordance with the records of the stratigraphical observations made from Black Butte to Rock Spring.* When I visited Point of Rocks for the purpose of studying the fossil plants of the locality, I could not discover any vegetable remains there and around, except Fucoids. But I made on the distribution of the strata the following remarks, copied from my report: "In following the railroad from Black Butte westward, the Lignitic formation already seen at the surface of the country from below Bitter Creek station, forms an irregularly broken ridge, whose general dip toward the east is varied by low undulations. In that way, the measures slowly ascend to Point of Rocks, where they overlie the black shale of the Cretaceous No. 4, there constituting the axis of an anticlinal, which is cut below Point of Rocks by the meanders of Bitter Creek. The counterface of the axis appears westward in corresponding strata after passing Saltwell Valley, and hence the dip to the west brings to the surface the upper strata of the Lignitic at Rock Spring. The section of the measures is perfectly clear and exposed in its whole length. At Point of Rocks,† and near the highest part of the anticlinal axis, the Cretaceous strata are exposed eighty feet in thickness, immediately and conformably overlaid by one hundred and eighty-five feet of the Lignitic sandstone, which from its base bears fuciodal remains." These data may be considered as correct in a general way; for I do not attach any importance to my measurements. Moreover, I am uncertain about the precise locality where the fossil plants here described have been found. According to the statement of Professor Hayden, the specimens sent to me were obtained near the station of Point of Rocks, and therefore at a distance of one mile or more east of the rocks forming the face of the anticlinal, and thus probably above them. From all these data here recorded, from stratigraphy and paleontology, the station of Point of Rocks may be considered as marking about the point of division between the Tertiary and the Cretaceous, in the so-called Bitter Creek series. The plants, therefore, of this locality are of great scientific interest.

Considering the remarks of European authors, who have already given their opinion in regard to the flora of our Lower Lignitic, it seems that its relation is still more evidently marked with Eocene types than I supposed. I have, indeed, mentioned *Viburnum marginatum* extremely abundant at Black Butte as related to one species of Sezane; one *Ficus* of Golden as identical with another of the same flora. Now Count Saporta, who is deeply interested in the progress of the botanical paleontology of this country, and who has seen some of the plates prepared for the Flora of the Liginitic, writes: "That *Sphenopteris Eocenica* is closely allied to *Asplenium Wegmanni*, Brgt., of Sezane; that species analogous to what I have described as *Abietites dubius* and *Abietites setigera* have been found in the Upper Cretaceous of St. Paulet, France; that our Palms,

* Dr. F. V. Hayden's Annual Report for 1872, p. 333.

† I name Point of Rocks the part of the anticlinal axis facing Saltwells Valley, not the station of Point of Rocks merely.

especially *Palmacites Goldianus*, denote Eocene; that the magnificent species *Sabal Grayana* is allied to, and perhaps an ancestor of, *Sabal major*, which in Europe appears at the beginning of the Miocene; and that *Flabellaria communis* is extremely similar to *Sabal adagavensis*, which is found in the Eocene Superior of the south of France, but which has not been figured till now. From all this and other points of *rapprochement* which the celebrated paleontologist of France makes in regard to the species of the lower group of the Lignite flora, he concludes as follows:* "In resuming, and notwithstanding that *Abietites*, which I consider as a Cretaceous type, your first group seems indeed to be legitimately Eocene, by its Ferns, its Palms, its coriaceous and prototypical Poplars, its *Cinnamomum*, and its *Viburnum*, as related to the Sezane flora, and by one of its Palms to the Upper Eocene of Angers. If one would suppose this flora more recent than the Eocene, he would have to admit such a dissemblance between Europe and America that every comparison by the floras between the geological stages of both continents should appear an impossibility." The assimilation of American species with a number of Miocene species published in Europe is considered by Saporta as doubtful and not quite conclusive; and he remarks also that though his opinion on the age of the Lower Lignitic group is given according to present impression, the great geographical distance renders the affinities between compared localities very difficult to fix with precision, even in supposing them contemporaneous.

These quotations must be excused by reason of the importance given now to the question of the age of the Lignitic, which, controversed in various ways, demands light, and has to be considered in every possible point of view. The problem is not yet solved. Requested, as I am, to contribute a share in the discussion, by closely adhering to paleontological evidence, and exposing it as far as it is given by fossil plants, I had to enter into details in order to show its weight. And no better opportunity could be afforded for this purpose than a review of the group of plants obtained from Point of Rocks by Dr. Hayden.

After completing the examination of Dr. F. V. Hayden's specimens, and when the manuscript had been already delivered to the printer, a friend of mine, Mr. William Cleburn, of Omaha, a zealous explorer and student of our American vegetable paleontology, sent to me a large box of specimens, obtained, most of them, from the same locality, Point of Rocks, where Dr. Hayden had discovered his own. These specimens tend to confirm, by some identical species and by relation of types of a few new ones, the evidence exposed already in regard to the age of this locality. It is, therefore, advisable to enumerate and describe them as an appendix to the above exposition. They are as follows:—

1. LEMNA ? BULLATA, Lsqx.

The species is represented by a few well-preserved specimens, clearly exhibiting the characters formerly described. All the fronds are mixed with floating rootlets.

2. SALVINIA ATTENUATA, *sp. nov.*

Leaves small, one centimeter or less in diameter, opposite, joined at the narrowed, slightly-pedicelled base, round or broadly oval, indistinctly reticulate by vertical and parallel rows of quadrate, large cells, marked in the middle by black spots, formed of very small, close cells, or pores, without any trace of a middle nerve.

* In letter, October 19, 1875.

This fine species is related by its reticulation and its size to *Salvinia Mildeana*, Heer (Balt. Flor., p. 17, Pl. III, figs. 1 and 2), differing from it by broader, less distinct, square areolæ, the absence of a dividing middle nerve, and the narrowing of the base to a very short pedicel. By these two last characters, this species is unlike any of this genus. It is, however, probable that the two leaves representing it were not, when embedded into the clay, in their full state of maturity, one of them being smaller than the other, and its areolation far less distinct. In the young leaves of the living *Salvinia natans*, the leaves, before attaining their full development, have the middle nerve scarcely discernible.

HABITAT.—Point of Rocks, *William Cleburn.*

3. SELAGINELLA FALCATA, Lsqx.

It has been described already, but merely from small detached branches and branchlets. The specimen of this lot represents a fragment of a stem ten centimeters long, one centimeter broad, round, but flattened by compression, covered with densely imbricate leaves of the same form and size as those of the branches. This stem proves the relation of the described fragments to the lycopodiaceous family.

4. SELAGINELLA LACINIATA, *sp. nov.?*

Branches dichotomously divided; divisions two to three centimeters long; leaflets? opposite, distichous, divided from the base in three to five filiform laciniæ, some of them forking at the middle, all curving upward or falcate.

By its mode of vegetation, the form and divisions of the pinnæ or branchlets, these small plants are exactly similar to those described from Dr. Hayden's specimens under the name of *Selaginella falcata.* The difference is in the remarkable laceration or thread-like divisions of the leaflets. The laciniæ distinct and in relievo upon the stone are like the veinlets of fern-leaves, when, by maceration and decomposition, their epidermis has been destroyed, or like skeletons of leaves. In this case, however, as these thread-like branches are more or less numerous, either simple or forking from the middle, and thus differing in number and mode of divisions for each leaflet, this appearance cannot result from decomposition in water. It is probable that these remains represent a a kind of lycopodiaceous plant, living sometimes partly immersed, and that, as it happens in numerous species of water-plants of this epoch, the immersed leaves become decomposed, and grow into laciniate divisions, while the emerged ones are entire or undivided. This difference in the leaves is particularly marked in *Nasturtium lacustre*, Gray, known to every botanist. I do not know, however, any Lycopodium species showing this kind of variations in leaves. Even *L. inundatum* has the leaves of the immersed part entire or without divisions. It is therefore uncertain if the specific separation of these fragments is authorizable.

HABITAT.—Point of Rocks, *William Cleburn.*

5. SEQUOIA BREVIFOLIA, Heer.

About one-half of the specimens of this locality have remains of this species; some have very fine large branches, but no cone has been as yet discovered.

6. WIDDRINGTONIA COMPLANATA, Lsqx.

The specimens of this species are better than those formerly examined. One has been figured, representing a tripinnately-divided branch; primary stems long, round flexuous, two millimeters thick, with distant, appressed, oblong, acute leaves; branches in various angles of divergence, and of variable length, either simple or pinnate or bipinnately subdivided; ultimate divisions obtuse, some slightly club-shaped.

7. FICUS ASARIFOLIA, Ett.

The same kind of leaves as those formerly described.

8. FICUS DALMATICA, Ett.

One of the specimens has a branch with two pairs of opposite leaves at a distance of two centimeters, and at its top, two branchlets, one broken, the other bearing an opening bud, with still half-folded leaves, indicating by the faces pressed against each other a conduplicate vernation.

9. FICUS PLANICOSTATA, Lsqx.

A young leaf preserved in its integrity. This species, as remarked already, is abundant at Black Butte.

10. DRYOPHYLLUM SUBFALCATUM, *sp. nov.*

Leaf subcoriaceous, linear-lanceolate, acuminate or sharply pointed; borders regularly serrate with short blunt teeth turned upward; lateral veins parallel, diverging thirty to forty degrees, straight to the point of the teeth; fibrillæ close, thin but distinct, simple or ramified in the middle, the upper ones joining nearly in right angle, a branch veinlet passing from near the point of the lateral veins under the sinuses, and following along and close to the borders.

There is only a fragmentary specimen of this species, the upper half of a leaf. By its form and nervation, it seems at first referable to the genus *Castanea*, and, truly, it would be easy to find leaves of the present *C. vesca* apparently perfectly similar to this fossil one. There is, however, a difference in the areolation, or in the arrangement of the tertiary veins. In these primary types of *Quercus* and *Castanea* described under the name of *Dryophyllum*, the upper branch of the secondary veins passes from near the point of the vein under the sinuses and closely follows the borders, which thus sometimes appear narrowly marginate, and is joined nearly at right angle by the upper fibrillæ. This character, though still indistinctly traced in the leaves of *Castanea*, and of some species of chestnut-oaks, is far less regular, the upper branches which follow the borders being of various sizes, not so exactly parallel to the borders, and not in close proximity to them. This new species is intimately related to *Dryophyllum Dewalquei* Sap. & Mer. (*Flore de Gelinden,*) especially to the fragment figured in Pl. III, fig. 2. It differs only by the shorter, less acute, teeth of the borders, the slightly falcate form of the leaf, and the close thin fibrillæ.

HABITAT.—Point of Rocks, *William Cleburn.*

11. POPULUS MELANARIOIDES, *sp. nov.*

Leaf subcoriaceous, nearly round, subtruncate at base, long-petioled; borders undulate; nervation ternate from above the base of the leaf, secondary veins two pairs, at a great distance from the primary ones, these much branched outside; the others simple, all the divisions passing to near the borders, where they become effaced in the areolation; nervilles thick, flexuous, in right angle to the veins, forming by ramification at right angle square polygonal meshes.

By the subcoriaceous substance, the long slender petiole of the leaves, this species is referable to the section of the *Trepidæ* (Trembling Poplars). As in *Populus tremulæfolia*, Sap. (Et., 3, 2, p. 26, Pl. III, fig. 4), to which this species is allied, the veins and their branches pass through the areas to very near the borders, which they seem to reach. The American form differs merely by less-distinctly undulate borders, the distance of the primary lateral nerves above the base, and by the great distance of the secondary veins. These two last characters are, how-

ever, of no moment for the specification of poplar-leaves, as can be remarked in the examination of a few leaves of the too common *Populus alba*. In fossil species, *Populus Massiliensis*, Sap. (Et., 3, 2, p. 30, Pl. II, fig. 6), is represented by three leaves, each of a different character of nervation. The relation of this species with that of the Tertiary (Miocene ?) of Provence, described by Saporta, may be therefore more intimate than it appears from the comparison of a single leaf. Our species is also comparable to *Populus heliadum*, Ung., by its form, and to *T. melanaria*, Heer, by its nervation.

HABITAT.—Point of Rocks, *William Cleburn.*

12. VIBURNUM MARGINATUM, Lsqx.

The specimen is fragmentary, but the species, very common at Black Butte, is recognizable.

13. DIOSPYROS BRACHYSEPALA, Al. Br.

Represented in good specimens.

14. TRAPA ? MICROPHYLLA, Lsqx.

Like the former, in good specimens, and described already from Dr. Hayden's collection.

15. GREVIOPSIS CLEBURNI, *sp. nov.*

Leaves of medium size, subcoriaceous, ovate, rounded, and narrowed by an inward curve to the short petiole, sinuato-denticulate, three-nerved from above the base; primary veins thick; secondary veins, two or three pairs, distant from each other, and also from the primary nerves, all branching outside with subdivisions or veinlets entering the teeth; nervilles in right angle to the veins, flexuous, simple, or branching in the middle; areolation obsolete.

This fine leaf, about five centimeters long (the point is broken), four centimeters broad in its widest part, below the middle, is so remarkably similar by its form, the denticulate borders, and the nervation, to *Greviopsis orbiculata*, Sap. (Sezane Fl., p. 411, Pl. XI, fig. 11 and 12), that its generic identity is positive. It specifically differs by its larger size, the more distant veins, and the double ramification of the primary nerves. This ramification is more distinct and more generally multiple, the branches forking before reaching the borders and curving along them. The leaf has, like those of the European species, a subbasilar marginal veinlet, which follows the borders, and is united by nervilles in right angle to the primary lateral nerves above.

HABITAT.—Point of Rocks, *William Cleburn.*

As said above, these species from Point of Rocks do not modify in the least the geological relation of the locality as indicated by its flora. Besides *Viburnum marginatum*, which is a most common plant of Black Butte, we have in Mr. Cleburn's specimens four new species only, not enumerated in the table of Dr. Hayden's, viz: *Salvinia attenuata*, *Populus melanarioides*, *Dryophyllum subfalcatum*, and *Greviopsis Cleburni*. The first two species have typical affinity with the Miocene: *Salvinia attenuata* with *S. Mildeana* of the Baltic flora; *Populus melanarioides* with *P. tremulæfolia* of the Marseilles basin. The other two are of Lower Eocene type: *Greviopsis Cleburni* related to the Sezane flora and *Dryophyllum subfalcatum* to that of Gelinden. The Tertiary character is therefore here also positively marked, while at the same time a relation to the Cretaceous is pointed out by the last-named species. Professor Schimper, in his *Paléontologie végétale*, has separated Sezane and Gelinden

from the Eocene, forming a lower subdivision, the *Paleocene*, for the plants representing the most ancient types of the Tertiary. The flora of Point of Rocks seems, in part, referable to this Paleocene division of the floras of Mount Bolca, of the *calcaires grossiers* of Paris, of the gypses of Du Puy, of the London clay, of the grès of Sarthe, of the lignites of Skopan, of the *argiles vertes* of Montmartre, and of the gypses of Aux, are to be considered as a group representing the true Eocene formations, we have to admit that till now at least, our lower Lignitic flora has little in its species to relate it to that formation. But then, it has mixed in it a number of Paleocene types and a preponderance of Submiocene or Oligocene species, and this proves a persistent general character of the whole flora from the base of the Lignitic at Point of Rocks to its upper part at Golden and Black Butte, where the predominance of more recent types becomes more marked as far as the old ones disappear. There is therefore no reason as yet to suppose that we have still, as they have in Europe, intermediate floras of a distinct and different character breaking the homogeneity of that of the Lignitic. Constituted as it is, in its comparison to the distribution of European flora, partly of Paleocene, or Lower Eocene types, partly of Oligocene, or Upper Eocene ones, this flora must, of a necessity, represent the North American Eocene.

Another lot of specimens, sent also by Mr. Cleburn, is from a locality as yet unknown to me, the Alkali stage-station, on the Sweetwater road, about thirty miles north of Green River station of the Union Pacific Railroad. The proprietor of the specimens has not himself visited the locality, and does not give any details on the position of the beds where the specimens were obtained. They represent only three species, all new ones, as follows:—

1. ALNITES UNEQUILATERALIS, *sp. nov.*

Leaves thin, variable in size, broadly oval or ovate-pointed, rounded to a short petiole; borders crenato-serrate; nervation pinnate; lateral veins irregular in number and distance, curving in passing to the borders, at an angle of divergenee of fifty to sixty degrees and entering the teeth by their ends or by small branchlets, when they pass under the teeth and follow the borders.

These leaves vary in size from four to eight centimeters long and from three to six centimeters broad, one of the sides measuring generally one-fourth in width more than the other. The irregularity in the number of the veins is correspondingly great; one of the leaves, the smallest for example, has, on one side, five lateral veins, the lower much branched outside, and on the other, ten, all simple. The largest of the leaves of this species, which is represented by a number of specimens, is related by form and nervation to *Populus Lebrunii*, Wat., which Saporta considers as referable to his *Alnus cardiophylla*. It is represented in the Sezane Flora, (Pl. XV, fig. 8). The general facies of the American leaves is, however, different, the teeth being broader and more obtuse, the nervation more distinctly pinnate, and the disposition of the veins to enter the teeth by their extremity more marked; and compared to *Alnus cardiophylla*, it is especially different by the constant inequality of the leaves. This last character and the irregularity of nervation are not of frequent occurrence in the leaves of *Alnus*. *Alnus viridis* and *A. serrulata* are, however, sometimes irregularly veined, and the inequality of the sides is seen in a number of fossil species, *Alnus cycladum*, Ung., especially *A. sporadum*, Sap.

HABITAT.—Alkali station, *William Cleburn*.

2. Juglans alkalina, *sp. nov.*

Leaves pinnately compound; leaflets lanceolate, tapering upward to a long acumen, either narrowed or rounded to a short petiole; borders crenulate; lateral veins distant, mostly alternate, parallel, separated by short intermediate tertiary veins, curving in passing toward the borders at an open angle of divergence, and ascending high along them in festoons; nervilles in right angle to the veins, branching in the middle, and forming by subdivisions irregularly quadrate or polygonal meshes.

This species is represented by four leaves, and its characters distinct. It is comparable to *Juglandites peramplus*, Sap., and *Juglandites cernuus*, Sap., both of the Sezane flora, partaking of some of the characters of both. It is, however, still more intimately allied to *Juglans Bilinica*, Heer (Flor. Tert. Helv., III, p. 90, Pl. CXXX, figs. 5–19), from which it merely differs by the position of the lateral veins at a more acute angle of divergence following higher up along the borders, and by the thicker and more numerous tertiary veins.

Habitat.—Alkali station, *William Cleburn.*

3. Carpites viburni, *sp. nov.*

Seeds or nutlets cordate obtuse, five to seven millimeters long, three or four millimeters broad, convex, grooved in the middle from the point to the base, surrounded by a membranaceous pellicle, the remains of an apparently fleshy outer envelope. They resemble seeds of a similar kind which I have found in great quantity at Golden, and referred to the genus *Viburnum.* Their form is like that of the seeds of *Viburnum Whymperi*, Heer (Spitz. Flor., p. 60, Pl. XIII, figs. 22 and 27).

Habitat.—Alkali station, *William Cleburn.*

These three species do not authorize a conclusion in regard to their geological age. As Mr. Cleburn informs me that a number of fragments of palm-leaves have been found in connection with his specimens, I am disposed to consider these plants as Eocene. None of these species has any relation to Cretaceous types, and the serrulate borders of the leaves, so marked in two species, is a character well defined in the leaves of the Sezane flora, and scarcely if ever in those of the Cretaceous.

NEW SPECIES OF TERTIARY FOSSIL PLANTS BRIEFLY DESCRIBED.

The following-described species have been discovered since the publication of the last annual report of Dr. F. V. Hayden's Geological Survey of the Territories. They are represented by specimens sent from different localities. These are indicated, with each species, as well as the name of the discoverer. All these species have been figured for the second volume of the Contributions to the Fossil Flora of the Western Territories.

1. Spheria rhytismoides, *sp. nov.*

The spots formed by this small fungus upon the bark of some stems and the leaves of a *Myrica* are composed of circular perithecia, placed five or six in a circle, forming thus a small crenulate ring. The perithecia become connected sometimes, apparently by decomposition; they are, however, generally separated. The size of the spots varies from one to two millimeters.

Habitat.—Black Butte, upon *Caulinites Sparganioides.*

2. HYPNUM HAYDENII, *sp. nov.*

Stem rigid, sparingly divided in nearly opposite, short branches, inflated toward the top, or club-shaped; leaves closely imbricated all around, lanceolate-acuminate or sharply pointed, concave. Comparable especially to *Hypnum Boscii*, Schwgr., an American species of the present time.

HABITAT.—South Park, near Castello Ranch, *Dr. F. V. Hayden.*

3. LYGODIUM MARVINEI, *sp. nov.*

A single leaflet of this fine species; simple, ligulate, obtuse, serrulate above, hastate at base; middle vein and veinlets distinct; veins forking once or twice. Allied to the living *Lygodium venustum*, a species which ranges from Mexico to Brazil.

HABITAT.—Top of gypsum series, Grand Eagle junction, *A. R. Marvine.*

4. LYGODIUM DENTONI, *sp. nov.*

Leaflets bi-tripartite, with short, obtuse divisions and broad sinuses, broadly triangular, rapidly narrowed to a subcordate or subtruncate base, entire, bi-trinerved from the base; primary nerves distinct, like the veins, which are forked once or twice, and become very close along the borders.

HABITAT.—Green River group, near the mouth of White into Green River, *Prof. William Denton.*

5. GONIOPTERIS PULCHELLA,? Heer.

An intermediate form, represented by mere fragments of pinnæ and separate pinnules. The shape of the pinnules united to the middle refers it to *G. pulchella*, while by the less-pointed leaflets and the nervation it represents *G. Fischeri* of the same author.

HABITAT.—Golden, in sandstone, above coal.

6. ZAMIOSTROBUS? MIRABILIS, *sp. nov.*

This species, whose reference to *Zamiæ* is not positively ascertained, is represented by a fragment, the half cross-section of a silicified cone, about fourteen centimeters in diameter. The outer surface is marked by the rhomboidal obtuse top of black seeds, or stony fruits, surrounded by a white vasculoso-cellular matter. In the cross-section of the cone, these seeds, of an enlarged rhomboidal form, three to three and a half centimeters long, six to eight millimeters broad, of the same size in their whole length, or slightly narrowed to the base, appear fixed or implanted into a zone of whitish, subpellucid mass of celluloso-vascular filaments. Under this ring of white matter, one centimeter thick, comes the central part, or axis of the cone, represented by mixed fragments of blackish opaque matter, agglutinated and amorphous. The fruits, or seeds, are represented by a black, compact, opaque silex, pierced in the length by large pores or ducts passing from the top to the base of the fruits. The intervals between them, nearly as large as the seeds, are filled by the same whitish celluloso-vascular matter which composes the white zone wherein the base of the fruits is embedded. The figure only of the specimen can give a good idea of this fragment of cone. It is distantly comparable, for the form and the disposition of its surface-scars, to *Androstrobus*, a genus established by Schimper for some cylindrical cycadeous male cones, formed of imbricated scales bearing sessile anthers on their lower surface. For the position of the fruits, it has a distant relation to *Zamiostrobus gibbus*, Reuss., a cone which

shows in its section oblong seeds, in right angle to the axis, with their tops appearing at the outside surface. Both these cones are figured in Schimper's Veget. Pal. (Pl. LXXII, figs. 1, 2, 14, 15.) There is, however, a great difference in the very large size and in the characters of this silicified strobile with those of a *Zamia*. It apparently represents a peculiar genus of the *Cycadineæ*.

HABITAT.—Found loose around Golden, *Dr. F. V. Hayden*.

7. SEQUOIA AFFINIS, *sp. nov.*

Branches long, slender, pinnately branching; leaves short, oblong, imbricated, and obtuse or longer lanceolate-acute, erect or slightly reflexed; branchlets bearing cones, open; strobiles small, round-oval, obtuse; scales large, rhomboidal, with entire borders, and a central oval mamilla, and wrinkles passing from it to the borders all around; male branches erect, with more acute and open leaves, resembling sterile branches of *Glyptostrobus Europeus*, with small, round catkins, covered to the top by imbricated lanceolate leaves.

This species, of which we have numerous and admirably well-preserved specimens, is much like *Sequoia Coutsiæ*, Heer, of the Bovey Tracy flora, differing, however, from it by the more obtuse point of the scale-like leaves, by more acute and longer leaves of the sterile branches, by more slender branchlets bearing cones at their ends, by proportionally larger, more oval cones (not globular), by the indistinctness of a middle nerve on the back of the leaves, which appear merely convex or inflated, etc. The seeds are of the same size as those of *S. Coutsiæ;* they differ also somewhat by cordate base and a mere trace of middle nerve near the top, where it divides and passes on both sides, curving along the borders.

HABITAT.—Middle Park, *Dr. F. V. Hayden*.

9. SEQUOIA ACUMINATA, *sp. nov.*

The form of the leaves is about the same as in *Sequoia longifolia;* they are, however, generally shorter, narrower, less crowded upon the stems, and especially distinct by the smooth surface of the leaves. In this species, the denudated branches are striate, while, in the former, they bear the scars of the base of the leaves. This difference, however, may be merely the result of decortication in the specimens representing this last species.

HABITAT.—Black Butte.

10. SEQUOIA ?, species.

Cones flattened, apparently long, linear-obtuse, marked at the surface by shields of scales, the only organs preserved. These are separated from each other, not continuous nor imbricate, rhomboidal in outline, with acute sides, and rounded top, bearing in the middle a round mamilla, from which wrinkled lines are diverging to the borders. The specimen represents two crushed cones, of which nothing can be seen but what is described here.

HABITAT.—Middle Park, *Dr. F. V. Hayden*.

11. ARUNDO REPERTA, *sp. nov.*

Stem thick, articulated; surface striated, marked with round, obtuse knots, either placed on the articulations or here and there upon the stem, without normal distribution; ear of seeds crushed, representing lanceolate glumes, sharp-pointed and rounded at base, and ovate-lanceolate-acute seeds, truncate at the base, with the center elevated or convex, apparently covered with a coating of hairs. The glume is longer than the seeds, and nerved in the middle.

HABITAT.—Green River, west of the station, *Dr. F. V. Hayden*.

12. ARUNDO OBTUSA, *sp. nov.*

Though the specimen is not as well preserved as that of the former species, the characters of the organs which it represents are discernible, and indicate a marked specific difference. The striæ or primary veins of the small fragment of a branch are thick, more distinct, and evidently separated by four or five thinner secondary veins; the glumes and pallets are shorter, equally striate, without middle nerve, and the seed is much shorter, broader, obtuse at one end, and truncate at the other. The fragment which I consider a pallet is slightly emarginate or truncate at the point.

HABITAT.—Golden, South Table Mountain.

13. PALMACITES GOLDIANUS, *sp. nov.*

Species representing a large fragment of a flabellate leaf with five to nine rays on each side, of a flat, narrow, linear rachis. Rays averaging one and a half centimeters broad, marked by deep, narrow furrows, without costæ, joining the rachis in an acute angle of twenty degrees, united to it by their whole undiminished base, without decurring along it. Surface somewhat shining; substance thick; primary veins distinct at least in some places, where the epidermis is destroyed, two to two and a half millimeters distant, separated by ten secondary veinlets, thin, but often discernible to the naked eyes.

HABITAT.—Golden.

14. FLABELLARIA COMMUNIS, *sp. nov.*

Leaves of medium size, borne upon a nearly flat or merely convex petiole, its top passing at the upper side into a short acuminate rachis, while on the lower side it is cut horizontally or nearly truncate; rays not very numerous, the lowest in right angle to the rachis, not descending lower than its base, rapidly enlarging, carinately folded near the point of attachment to the rachis, becoming mostly flat or scarcely carinate upward; carinæ narrowly costate; primary veins broad, generally black when the epidermis is removed, one to two millimeters apart; intermediate veins thin and numerous, averaging twelve in the large intervals of two millimeters.

HABITAT.—Golden, where it is common.

15. MYRICA LUDWIGII, Schp.

Leaves of middle size, subcoriaceous, oblong or linear-lanceolate, gradually tapering into a long entire acumen, distantly and deeply dentate along the borders; middle nerve thick; secondary veins subopposite, open, parallel, curving in passing to the borders, camptodrome, forking at the base of the teeth, the branches entering them, while the top of the veins is curved along the borders.

HABITAT.—Green River group, near mouth of White River, *Prof. W. Denton.*

16. MYRICA SAPORTANA, *sp. nov.*

Leaf membranaceous, large, narrowly-oval or oblong acuminate, pinnately-lobed; lobes short, entire, turned upward, triangular-acute; lateral veins open, slightly curving in passing to the point of the lobes; tertiary veins nearly as thick as the secondary ones, forking under the acute sinuses of the lobes, the branches ascending along the sides; areolation large, polygonal, formed by the anastomosis in the middle of the areas of nervilles at right angle to the veins. There are of this beautiful species two fragments of leaves, indicating the average size of ten centimeters

long and four centimeters broad. The point, as in the former species, is entire, and still more rapidly and acutely acuminate, and the lobes alternate, short, equal and similar, give to this species a beautiful appearance.

HABITAT.—Middle Park, *Dr. F. V. Hayden.*

17. MYRICA LESSIGIANA, *sp. nov.*

This species is represented by nearly the half of a leaf, enormous, at least, for the genus. Leaf linear, oblong in outline, deeply lobed; lobes opposite, ovate-lanceolate, obtusely pointed, at an open angle of divergence, entire, joined at a short distance of the thick middle nerve in obtuse sinuses; lateral veins thick, subopposite on an open angle of divergence, ascending to the point of the lobes, ramified from the middle upward in branches curving to and along the borders; tertiary veins variable in thickness, relative position and direction, some forking under the sinuses, and passing up on both sides of it; others traversing the large intervals between the base of the secondary veins and the borders of the lobes, and following the borders in multiple festoons; areolation of the same character as in the former species, the large areolæ, however, being subdivided in very small meshes of the same character.

This magnificent leaf seems of a pellucid texture, though thick; at least, all the details of areolation and nervation are distinctly perceivable in black upon the chestnut-color of the leaf. Though the fragment does not represent one-half of the leaf, the terminal leaflet being destroyed, and the base also, still it is twenty-three centimeters long and eighteen centimeters broad, each lobe being nine to ten centimeters long from the middle nerve to the point, and seven and a half centimeters broad between the sinuses. This leaf represents, as the former, a species of the section of the *Comptonia*, like *Comptonia grandifolia*, Ung., which was till now considered as the giant representative of the section, but whose leaf is scarcely half as as large as this.

HABITAT.—Found in connection with a bed of lignite west of Denver, Colo., and kindly communicated by *Mr. W. H. Lessig*, who discovered it, and had the specimen framed in a bedding of plaster.

18. BETULA VOGDESII, *sp. nov.*

Leaves small, ovate, acutely-pointed, rounded, and narrowed to the petiole, minutely serrulate, penninerve; lateral veins distant, opposite at or near the base, simple or rarely branching, passing up in an angle of divergence of thirty to thirty-five degrees, nearly straight to the borders, craspedodrome; details of areolation obsolete.

HABITAT.—Near Fort Fetterman, in connection with a profusion of remains of *Taxodium distichum*, *Lieutenant Vogdes.*

19. CASTANEA INTERMEDIA, *sp. nov.*

Leaves proportionally long and narrow, linear-lanceolate pointed, narrowed to the base; borders equally and sharply dentate; teeth accuminate, turned upward; areolation and nervation similar to that of *Castanea vesca*. By its character it is intermediate between *Castanea Ungeri* of the Miocene and *C. vesca.*

HABITAT.—Middle Park, *Dr. F. V. Hayden.*

20. CARPINUS GRANDIS, Ung.

This species, so common in the Miocene of Europe, is represented in our flora by a number of leaves identical in all the characters.

HABITAT.—Near Florissant, South Park, *Dr. F. V. Hayden.*

21. QUERCUS HAIDINGERI, Ett.

Leaf ovate-lanceolate, narrowed to the base (point broken); borders obtusely crenato-serrate; lateral veins numerous, close, on an angle of divergence of forty to forty-five degrees, rarely branching, camptodrome and craspedodrome. The leaf appears to be tapering to a point. It is upon coarse sandstone, and the details of areolation are totally obliterated. By its form, the divisions of the borders, and the nervation, it agrees with the characters of the species, except that in this leaf the middle nerve is not thick, as described by Heer.

HABITAT.—Green River, *Dr. F. V. Hayden.*

22. PLANERA UNGERI, Ett.

Leaves short petioled, ovate, acuminate, narrowed to the base, simply, coarsely serrate from the middle upward; secondary veins nine pairs, passing up to the point of the teeth in an acute angle of divergence. This form, though represented by one leaf only, is in entire concordance of characters with those of this species widely distributed in the Miocene of Europe.

HABITAT.—South Park, *Capt. Ed. Berthoud.*

23. FICUS OVALIS, *sp. nov.*

The only leaf representing this species is coriaceous, oval, entire, narrowing in a curve to a long thick or flat broad petiole, grooved in the middle penninerve; lateral veins alternate, camptodrome, curving along the borders in festoons; tertiary veins short; areolation obsolete. The upper part of the leaf is broken.

HABITAT.—Pleasant Park, Plum Creek, *Dr. F. V. Hayden.*

24. FICUS PSEUDO-POPULUS, *sp. nov.*

Leaves oval-pointed, narrowed to the petiole, entire, three-nerved from the top of the petiole; lateral veins at an acute angle of divergence, like the secondary veins, two or three pairs, the lower of which is at a great distance from the primary ones, camptodrome; nervilles distinct, in right angle to the midrib, crossed by oblique branchlets, forming a large equilateral or polygonal areolation. A remarkable species, resembling a *Cinnamomum* by the nervation of its leaves and a *Zizyphus* by the form.

HABITAT.—Evanston, *Dr. F. V. Hayden.*

25. FICUS WYOMINGIANA, *sp. nov.*

May be a variety of the former, resembling it closely by the form of the entire, long, petioled leaf. The difference is marked, however, by the total absence of secondary veins; the middle nerve being joined to the lateral ones by strong nervilles in right angle.

HABITAT.—West of Green River station, *Dr. F. V. Hayden.*

26. DIOSPYRAS? FICOIDEA, *sp. nov.*

Leaf ovate, narrowed to a point (broken), rounded to the petiole, thickish, entire, pinnately-nerved; midrib thick, deeply marked, as also the secondary veins, parallel, at an acute angle of divergence, all doubly camptodrome; fibrillæ thick, nearly in right angle to the veins, divided in the middle; areolation square or polygonal; surface rough. The generic relation of these leaves is not satisfactorily fixed.

HABITAT.—Black Butte.

27. VIBURNUM PLATANOIDES, *sp. nov.*

This species essentially differs from *Viburnum marginatum* by the less

numerous, more open, lateral veins, whose branches are more curved in passing up to the borders, and especially by the enlarged truncate or subtruncate base of the leaves. The direction of the veins along the lower branches of the lateral veins is the same, and the borders are dentate in the same manner, though not black-margined as in V. *marginatum.*

HABITAT.—Black Butte, mixed with Saurian bones, and as abundant in that bed as is its congener, in the shale above the main coal of the same locality.

28. CISSUS PAROTTIÆFOLIA, *sp. nov.*

Leaves ovate-subcordate or narrowed to the base, gradually and obtusely pointed, undulato-crenate, three-nerved from the top of the petiole or from a little above the border-base; lower secondary veins at a distance from the primary ones, which are much divided; all the branches, like the secondary veins, craspedodrome; nervilles strong, in right angle to the veins; areolation small, square, by subdivision of veinlets.

The species is represented by a few leaves, one of them fragmentary, has a cordate, unequal base, and may represent a different species.

HABITAT.—Green River, west of the station, *Dr. F. V. Hayden.*

29. RHAMNUS ROSSMÄSSLERI?, Heer.

Leaves oblong-obovate, obtusely pointed, entire, narrowed to the base, penninerve; secondary veins close, parallel, passing to the borders nearly straight and curving along them in festoons. These leaves are small; one only is preserved entire; their specific relation is not fixed.

HABITAT.—Black Butte.

30. PHASEOLITES JUGLANDINUS?, Heer.

Leaflets of an apparently compound leaf, oval-oblong, obtusely pointed, rounded to a short petiole, entire, subcoriaceous, penninerve; lateral veins parallel, distinctly camptodrome, and following the borders in festoons; ultimate areolation small, irregularly quadrate.

The species may be different from the European one bearing this name, but it appears to differ only by more open secondary veins.

HABITAT.—Green River group, near mouth of White River, *Prof. Wm. Denton.*

31. LEGUMINOSITES ALTERNANS, *sp. nov.*

Leaflet lanceolate, narrowed to the sessile base (point broken), apparently tapering and acute; borders entire; secondary veins close, numerous, fifteen pairs in a space of two and a half centimeters, with intermediate shorter tertiary veins anastomosing by crossing veinlets; areolation obsolete. This leaf is comparable to a *Dalbergia* or a *Podogonium* by its nervation; its form, especially the narrowed base, is comparable to *Cassia.*

HABITAT.—Near mouth of White River, *W. Denton.*

32. SAPINDUS DENTONI, *sp. nov.*

Leaves lanceolate, gradually narrowed to a long acumen, unequilateral and rounded at base to a short petiole, entire or slightly undulate, thick; secondary veins close, parallel, diverging forty to fifty degrees, thick, straight to the borders, where they abruptly curve, and which they closely follow.

Species allied to *Sapindus falcifolius*, Heer, but remarkably distinct from this and other congeners by the thick, close, lateral veins straight to the borders, where they curve so abruptly that they appear at first

sight as craspedodrome. The areolation is of the same character as that of *S. falcifolius.*

HABITAT.—Green River group, near mouth of White River, *Prof. W. Denton.*

33. LOMATIA MICROPHYLLA, *sp. nov.*

Leaves very small, thick, coriaceous, linear-lanceolate, gradually narrowed to a point, and in the same degree to the base; secondary veins simple, thin, in an open angle of divergence, connected to a marginal vein. We have two leaves of this fine species. It is comparable to *Lomatia firma*, Heer, of the Baltic flora, but very small and thick; the surface mostly covered by a coating of coaly matter.

HABITAT.—Same locality as the former, *Prof. W. Denton.*

A large number of fruits and seeds, considered under the name of *Palmacites*, *Carpolites*, etc., have been figured for the Lignitic Flora. As the characters of these organs cannot be represented by mere description, they are not mentioned in this short synopsis.

NEW SPECIES OF FOSSIL PLANTS FROM THE CRETACEOUS FORMATION OF THE DAKOTA GROUP.

Since the publication of the first part of the Contributions to the Fossil Floras of the Western Territories, the paleontological explorations continued in Kansas, especially by Messrs. H. C. Towner and Charles Sternberg, have procured a number of fine specimens, representing new species or varieties of forms as yet unsatisfactorily known, which afford some important information in regard to the characters of the remarkable vegetation of the Cretaceous period. As it has been done for the plants of the Tertiary, it is appropriate to give now an abridged description of the new Cretaceous species, reserving for the next annual report of Dr. F. V. Hayden a revision of the species which have been formerly published, and a more detailed description with figures of the new ones added to the Cretaceous flora of the United States by recent discoveries.

1. Gleichenia Nordenskioldi, Heer.

Frond slender, dichotomous, apparently bipinnate; pinnæ close to each other, open, linear, parallel, with minute, free, oblong, or ovate-obtuse pinnules, rounded at base, turned upward; secondary veins few, three or four pairs, the lower forking, the upper simple.

In the Greenland specimens, the fructifications are marked by two large *sori* at the base of the pinnules, one on each side of the middle nerve. The specimens from Kansas are sterile.

2. Sequoia condita, *sp. nov.*

Branches very slender, rigid, pinnately divided; branchlets oblique or open, filiform, generally embedded in the stone, or leaving merely deep impressions within or upon the matrix; leaves narrowly elliptical or oblong, acute, slightly narrowed to the base, closely appressed, distantly imbricated, alternate, and nerveless. Cone small, oval, obtuse; male catkin relatively large, ovate, obtuse.

The remains of this species, which fill some specimens with their impressions of branches, branchlets, and scarcely perceivable leaves, could be, but for the ramification, considered as identical with those described in the Cretaceous Flora as *Glyptostrobus gracillimus*. The three cones, found embedded upon the same specimen as the branches and the male catkin, prove that this peculiar species is a *Sequoia*, though the leaves are so small that the relation of their base to the branches or the decurring border cannot be positively recognized.

3. Sequoia fastigiata?, Sternb.

Branches and branchlets erect, filiform, fastigiate; leaves loosely imbricated, small, decurrent at the base, lanceolate-acuminate, more or less curved upward, nerved.

There is of this species a small branch only. All the characters of

ramification, form, and direction of leaves agree with the species as it is represented by Heer from specimens of the Upper Cretaceous of Greenland, and especially as it is figured in the Moletin Flora by the same author. Schimper admits as a synonym of this species *Frenelites Reichii*, Ett., to which *Glyptostrobus gracillimus* of the Cretaceous Flora was compared, and supposed to be identical. This last species would, therefore, be referable also to this *Sequoia*. Its generic relation is indicated, indeed, by the scales of a cone found upon the same specimen and figured in Pl. I, fig. 8, and the specific affinity by the fastigiate ramification. Now this so-called *Glyptostrobus* has its stems and branches still more slender, and its leaves still smaller than *Sequoia condita*, and if it is referable to *S. fastigiata*, the new *Sequoia*, whose cones are similar to those of *S. fastigiata*, has nothing of a different character to separate it but its ramification. The question may be settled by the discovery of more complete specimens.

4. SEQUOIA SUBULATA?, Heer.

Branches erect; branchlets filiform; leaves narrow, subulate, decurrent at base, erect or falcate.

Of this form we have a mere branchlet, which, but for its narrow subulate leaves, could be referred to *Sequoia Reichenbachi*, Heer. Like the former, its exact relation is still uncertain.

5. PINUS QUENDSTEDTI, Heer.

Leaves by five, very long and narrow, filiform, nerved in the middle; cones long, subcylindrical; surface (apophise) of the scale broadly rhomboidal; central mamilla round.

This species is represented by a number of specimens from Fort Harker. They are fragmentary; but the form of the long subcylindrical cones, that of their scales, and the extremely narrow, concave, nerved leaves, are all unmistakable characters which identify this species with that of Moletin.

6. INOLEPIS?, *sp.*

Small round cone or fruit attached to a branch mixed with undeterminable remains of Conifers. The impression of the large body is deep-semi-globular, indistinctly marked from the point of attachment to near the top by five obtuse costæ, or narrow ribs, coming together and disappearing below the top. The other fragments, on the same branch and above this, appear like scales of a small open cone. This may be compared to the part figured in the Artic Cretaceous Flora of Heer (vol. III, Pl. XVI, fig. 16), in supposing that it represents a cross-section of a small cone seen undeveloped and entire upon our specimen. These remains have been figured for a future elucidation by better preserved specimens.

7. MYRICA CRETACEA, *sp. nov.*

Leaves long, linear-lanceolate (point broken), gradually narrowed downward to a short thick petiole; middle nerve thick; lateral veins on an acute angle of divergence, ramified, the branches anastomosing with intermediate tertiary shorter veins, camptodrome; borders minutely serrate; substance subcoriaceous; surface polished.

Comparable by the acute angle of divergence of the veins to a number of species of *Myrica* of the Lower Eocene of Europe, and also more doubtfully referable to *Lomatia*.

8. DRYOPHYLLUM (QUERCUS) LATIFOLIUM, *sp. nov.*

Leaf large, oval, obtuse at the top and base, sinuate-dentate, with teeth obtuse or obtusely pointed; lateral veins on an acute angle of divergence, straight to the borders, forking once or twice.

The characters of nervation, especially of the secondary and tertiary veinlets, are comparable to those of the Chestnut, as the secondary veins enter the teeth, and thick nervilles pass out of them from near and along the borders. This last character, however, is the same in the species of Oaks of Cretaceous origin, which have been referred to the genus *Dryophyllum.* In this leaf the veins fork once and near the base twice, as in some leaves of *Castanea. Castanea Hausmanni*, Drk., from the *Quadersandstein* of Blankenburg, is closely allied to this species.

9. POPULUS ARISTOLOCHIOIDES, *sp. nov.*

Leaves thick, coriaceous, broadly ovate-obtuse, round or truncate at base, entire, five-nerved from the top of the petiole; lower primary veins open, with one pair of thin marginal veins underneath; inner lateral veins oblique at a more acute angle of divergence than the secondary ones, all branching, thick, or inflated, anastomosing in curves toward and along the borders.

The top of the leaf is erased, but it appears to be obtuse or obtusely pointed. By its consistence and its nervation, this species is referable to the section of the coriaceous Poplars. It is comparable also to species of *Aristolochia.*

10. FICUS DISTORTA, *sp. nov.*

Fragment representing the upper half of an obovate, unequilateral, pointed leaf, apparently narrowed to the base, with a thick pinnate nervation; upper secondary veins, six pairs, diverging forty degrees, close, equidistant, and parallel, curving abruptly near the borders, which they follow in double festoons. The nervation of this fragment, its areolation, both very distinct, and also the unequilateral shape of the leaf, refer it to *Ficus.*

11. LAURUS PROTEÆFOLIA, *sp. nov.*

Leaves subcoriaceous, long, lanceolate, tapering up from below the middle to a long acumen, narrowed to the base; middle nerve grooved; lateral veins oblique, thirty degrees, thin, curving to and along the borders, parallel, except the lower pair, which is more oblique. The form of these leaves is similar to that of *Proteoides daphnogenoides*, as represented in the Cretaceous Flora (Pl. XV, figs. 1 and 2).

12. ANDROMEDA ACUMINATA, *sp. nov.*

Leaf thickish, narrowly lanceolate, narrowed to a long acumen, gradually decreasing to the base, borders entire; middle nerve thick; lateral veins close, parallel, subequidistant, in an acute angle of divergence; areolation minute, punctate.

This species is related to *Andromeda Parlatori*, Heer, of the Cretaceous formations; but the nervation is different.

13. ARISTOLOCHITES INFUNDIBULIFORMIS, *sp. nov.*

Leaf coriaceous, entire, broadly ovate, peltate, five-nerved from the upper part of the point of attachment of the petiole; lower veins nearly

in right angle to the middle; intermediate ones in an acute angle of divergence, curving up toward the point, and anastomosing with secondary veins, and their branches all camptodrome.

This leaf is deeply convex toward the point of attachment of the petiole far above the border-base, or nearer to the middle than to the base; it is thus about exactly funnel-form, the top of the petiole being marked by a hollow stalk penetrating the stone. Under the lowest pair of veins, the nervation and areolation totally disappear, being only indicated by short wrinkles at the mouth of the hollow of the petiole.

In comparing this leaf with *Aristolochites dentata*, Heer, in Cretaceous Flora (Pl. XXX, fig. 6), the generic relation marked by form of leaves and nervation is easily recognized. By the character of nervation, also, this leaf has a great likeness to the one which is described above under the name of *Populus aristolochioides*.

14. ARALIA TRIPARTITA, *sp. nov.*

A three-palmately-divided, small leaf, cut to two-thirds of its length in three nearly equal narrow, linear, obtuse lobes, about five centimeters long, one centimeter wide, perfectly entire, the lateral ones diverging at an angle of thirty degrees, and joined to the middle one by narrow, obtuse sinuses; the leaf is three-nerved from the base; no trace of secondary veins or of areolation is distinguishable.

The texture of this leaf is coriaceous. Though it has no distinct nervation, it is referable to the genus *Aralia*, and comparable to living species of the section of the *Oreopanax*.

15. ARALIA QUINQUEPARTITA, Lsqx.

This species, described and figured in the Cretaceous Flora (p. 90, Pl. XV, fig. 6), from a mere fragment representing only the lower part of a leaf, is now known from large, nearly complete leaves, deeply five-lobed, with long, narrow, linear-lanceolate lobes, distantly dentate from the middle to the point; the base of the leaf is gradually narrowed and decurrent.

The primary nervation is the same as in the following species; but the subdivisions are totally obsolete, the substance of the leaves being subcoriaceous and polished.

16. ARALIA SAPORTANA, *sp. nov.*

Leaves very variable in size, palmately five-lobed, narrowed to a long petiole; lobes shorter than in the former species, cut to the middle of the leaves, distantly and obtusely dentate from a little above the obtuse sinuses, lanceolate, obtusely pointed; primary nerves three from a little above the base of the leaves, the lateral ones forking, all of the same thickness; secondary veins parallel, equidistant, entering the teeth; nervilles in right angle, deeply marked, forming by divisions a quadrangular, small areolation.

This species is represented by a number of fine leaves, variable in size, from nine to eighteen centimeters long and from nine to twenty centimeters broad, between the points of the external lobes. The lowest pair of secondary veins is camptodrome, curving along and following the borders near the base, where they are generally entire.

17. ARALIA CONCRETA, *sp. nov.*

Leaves small, very thick, coriaceous, palmately five-lobed to below the middle, narrowed to a thick petiole, entire; primary veins three from the top of the petiole, or from a little above the border-base of the leaves,

the lateral ones forking, all thick, flat, and deep, passing up to the point of the obtuse lobes in preserving the same thickness.

No trace of secondary nervation or reticulation is observable on these leaves, of which we have a number of specimens. One of them has an abnormal division, one only of the lateral veins being forked, and, therefore, the leaf is four-lobed, with one of its sides in an acute angle to the petiole, while the other is open, nearly truncate, or in right angle to the petiole.

18. ARALIA SEMI-ORBICULATA, *sp. nov.*

This species differs essentially from the former by the base rounded to the petiole. The thickness of the primary veins and of the texture of the leaves is the same as in the former species; the lobes are, however, unequal in width, and the external sinuses acute. Though the shape is far different from that of the leaves of the former species, it may represent a mere variety. The external lateral veins curve more or less inward, and the borders follow this curve, which is contrary to the normal direction of the lateral veins of a five-lobate leaf. As we have one specimen only representing it, the persistence of the specific? character is uncertain.

19. ARALIA TOWNERI, *sp. nov.*

Leaves large, coriaceous, palmately five-lobed to below the middle; lobes oblong, obtuse or obtusely pointed, entire; primary nerves three from the top of the petiole, the lateral ones forking; secondary veins on an open angle of divergence, thin, curving to and along the borders, camptodrome; areolation equally distinct, quadrate or polygonal by the subdivision of veinlets at right angle to the veins.

Two external lobes only of this beautiful species are preserved; they, however, distinctly show the characters of a whole leaf. The nervation and areolation are of a type far different from that of *Aralia Saportana;* the first is related to that of *Sassafras;* this to *Aralia.*

20. HEDERA SCHIMPERI, *sp. nov.*

Leaf subreniform, broader than long, rounded at the top, abruptly narrowed or broadly cuneate to a short petiole enlarged at its base; three-nerved from above the base; lateral veins curving toward the borders, one directed inward, the other outward, anastomosing by thick branches and nervilles with the branches of the short distant secondary veins, curving along the borders, reaching the slightly distantly denticulate borders by short veinlets.

The nervilles by subdivision in right angle form broad equilateral or polygonal areas; the borders at or near the base are followed by one or two pairs of marginal veins anastomosing in curves, and by nervilles to the veins above. Except that the secondary veins are alternate, this leaf closely resembles, by its nervation and areolation, the common Ivy (*Hedra helix*). It is, however, far different by the form of the leaf and especially by its short petiole.

GENUS AMPELOPHYLLUM, *gen. nov.*

Leaves round in outline or broadly obtuse, round, truncate, or more or less attenuated to the base with entire or undulate borders; three-nerved from the top of the petiole or from a distance above the base; lateral primary veins branching; marginal veinlets one or two pairs or more; secondary veins either opposite and at equal distance, or alter-

nate and more distant from the primary nerves, mostly simple, all, craspedodrome like their branches.

Besides the following species, I refer to this division some of the leaves described in the Cretaceous Flora under the name of *Populites*, these being by their nervation without analogy to any species of *Populus*. These are: *Populites cyclophylla?*, Heer, as figured Pl. IV, fig. 5, and Pl. XXIV, fig. 4; *Populites* (*Celtis*) *ovata*, Lsqx., Pl. IV, figs. 2 and 3, and also with an analogy somewhat less marked to the *Ampelideæ*, however; *Populites Lancastriensis*, Pl. III, fig. 1; and *P. elegans*, Pl. III, fig. 3.

21. AMPELOPHYLLUM FIRMUM, *sp. nov.*

Leaf coriaceous, small, entire, nearly round, broadly obtuse at the top and round truncate to a short petiole, three-nerved; secondary veins three pairs, alternate, irregular in distance, passing to the borders in the same angle of divergence as the primary lateral veins; fibrilles thick, in right angle to the veins, connected by cross branchlets.

The areolation is comparable to that of the leaves described below as *Credneria;* the petiole, however, is short, inflated at its base; it is especially similar to that of the following species.

22. AMPELOPHYLLUM ATTENUATUM, *sp. nov.*

Leaf subcoriaceous, broadly obovate, rounded at the top, narrowed to a slender petiole, with borders undulate, entire from the middle downward; nervation trifid from a distance above the base of the leaf, with marginal veinlets underneath; secondary veins two or three pairs, irregular in distance; divisions of the veins and areolation same as in the former species.

The base of the primary veins is at a greater distance from the top of the petiole than in the former species; but if we consider the modifications in relation to the borders narrowed to the base, we find exactly the same characters of nervation. The midrib is narrower, as also the petiole, which appears proportionally longer, but is broken, and therefore its length is uncertain.

23. CISSITES HEERII, *sp. nov.*

Leaf thick, coriaceous, smooth or nearly polished, enlarged upward or fan-like, rounded and subcordate to the petiole, equally divided at the top in five short, acute lobes, separated by broad sinuses, triple-nerved from above the base; lower pair of secondary veins as thick as the primary nerves, passing up to the point of the lobes; upper secondary veins and all the divisions thin, curving to and along the borders which they closely follow in a continuous simple festoon.

The form of this leaf and its nervation refer it to *Cissus*, and its general character to *Cissites insignis*, Heer, represented by mere small fragments of two lobes in the *Phyllites* of Nebraska.

24. CISSITES ACUMINATUS, *sp. nov.*

Leaves thick, subcoriaceous, deltoid-acuminate, rounded to the petiole, entire, three-nerved from the base; secondary veins five pairs at equal distance, subopposite, camptodrome, like the branches of the primary lateral veins, which form indistinct lateral lobes at the point of contact to the nerves.

These leaves are, like the former, referable to species of *Cissus* by their shape and nervation. They have a great likeness to the leaves described and figured in the Cretaceous Flora as *Sassafras Harkerianum*, and which should be placed under the same generic denomination of *Cissites*.

25. CISSITES HARKERIANUS, Lsqx.

Sassafras Harkeianum, Lsqx., Cret. Flora, p. 81, Pl. XI, figs. 3, 4, and Pl. XXVII, fig. 2.

One leaf is separately figured, and doubtfully referred to this species. It is thick, nearly round, enlarged on the sides, very obtuse at the top, and broadly wedge-form at the base, petioled, perfectly entire, three-nerved from above the base, with two pairs only of craspedodrome parallel, and equilateral veinlets. It is much smaller than any of the leaves formerly figured. The lateral lobes are scarcely distinguishable, the leaf being nearly round, the secondary veins curving near the point of attachment to the midrib, pass up straight to the borders in the same angle of divergence of fifty degrees, as that of the primary lateral veins.

26. HAMAMELITES KANSASEANUS, Lsqx.

This fine leaf completes the one figured and described in Cretaceous Flora (p. 62, Pl. XXX, fig. 8), under the name of *Alnus Kansaseana*. The leaf is obovate, narrowly truncate at the slightly peltate and narrowed base, regularly undulate-dentate, pinnately nerved, with six pairs of alternate secondary veins and two pairs of nearly horizontal marginal veinlets underneath; the veins are all craspedodrome, straight from the midrib to the border, the lower ones ramified, and all joined by distinct strong nervilles in right angle.

Except that the base is slightly peltate, this leaf has all the characters of the genus *Hamamelis*. The leaf figured and described in the Cretaceous Flora (p. 62, Pl. IV, fig. 1) as *Alnites quadrangularis* belongs probably to the same generic division.

27. CREDNERIA? MICROPHYLLA, *sp. nov.*

Leaves coriaceous, round, entire, long-petioled; nervation pinnate, with seven pairs of alternate laternal veins, and two pairs of marginal horizontal veinlets underneath.

The lateral veins are more open and closer toward the base, the three or four lower pair branching, and all thick craspedodrome, joined by thick fibrillæ. But for the non-peltate base of the leaves, they should be described under the generic division of *Protophyllum*, having a similarity of nervation with *Protophyllum minus*. The large base of the leaves, the two horizontal strong veinlets under the principal lateral veins, give to this species represented by many specimens an appearance strikingly similar to that of *Credneria acuminata* and *C. integerrima*, Zenk. There is, however, a marked difference in the camptodrome nervation. Another leaf figured like the former appears to be a variety of the same, the difference being only in the deeply undulate border. In this leaf, still much smaller than the former, the details of areolation are discernible, the netting being formed of small meshes nearly exactly rectangular by subdivisions of the fibrillæ in veinlet, at right angle; the veinlets following parallel and close to the borders are still more distinct and their position more definite than in the larger leaf.

28. PROTOPHYLLUM? TRILOBATUM, *sp. nov.*

Leaves very large, thick, coriaceous, palmately three-lobed, deeply and coarsely nerved, three-nerved from a distance above the base of the petiole or the point where it passes under the auricle, peltate; lateral veins open, angle of divergence sixty degrees. Secondary veins close, camptodrome or craspedodrome.

These fine leaves, of which a comparatively large number has been discovered in Kansas, have the character of the species which has been

named *Sassafras* (*Araliopsis*) *mirabile* (Cretaceous Flora), by the three-lobate upper part of the leaves and by their nervation; the borders either entire, and followed by camptodrome secondary veins, or, obscurely dentate and entered by craspedodrome ones, are also of the same type; the base, however, refers them to *Pterospermites*, they being not only peltate, but having under the lateral veins strong vertical secondary ones, which thin and pass to mere marginal veinlets, surrounding the base of the midrib and filling the broad rounded auricle by their divisions. There was place upon the plate for the smallest of the leaves only. We have other specimens, more or less fragmentary, however, which bear remains of leaves of this species at least one foot in diameter. The coarse nervation and areolation, the closely secondary veins, are, of the same character as in *Sassafras obtusum*, as figured in Pl. XIII, fig. 1, of the Cretaceous Flora.

29. MENISPERMITES OVALIS, *sp. nov.*

Leaf oblong, obtuse, entire, rounded to the base, three-nerved from the top of the petiole; lateral veins ascending in a curve parallel to the borders to near the top, where they anastomose with branches of the midrib, bearing two strong branches at their base, and higher up short oblique parallel branches, curving and anastomosing in festoons along the borders.

This fine leaf resembles, by some of its characters, being, however, much shorter, *Daphogene Kanii*, published by Professor Heer, from the Miocene of Greenland, in Flora Arctica (vol. I, p. 112, Pl. XIV, and Pl. XVI, fig. 1). Its general form and especially the nervation are the same. The author is somewhat uncertain in regard to the relation of this species. We have obtained a perfect specimen, with distinct nervation and areolation of the leaves, described in the Cretaceous Flora under the name of *Menispermites obtusiloba*. It has been carefully figured for the next annual report of Dr. F. V. Hayden. This leaf, much smaller than those formerly figured in the Cretaceous Flora, has the characters of nervation in exact concordance with those of this new species, and, therefore, it appears judicious to place them both under the same generic division. The texture of this leaf, which is finely preserved, is somewhat thick, subcoreaceous, and the nervation distinct, as well as the areolation.

ADDITION.

Mr. William H. Holmes, returning from this year's expedition of the geological survey under the direction of Dr. F. V. Hayden, (1875), has lately brought to me a number of specimens from Southwest Colorado, in the vicinity of San Juan River. They represent two horizons of the Cretaceous, as far, at least, as conclusions can be obtained from a small lot of specimens, which, unhappily, are very fragmentary. The leaves of the lower stage, upon red, coarse, sandy shale, of the same appearance and compound as are those of the Dakota group at some exposition of the rocks, represent especially *Magnolia alternans*, Heer, one of the common species of the Cretaceous of Nebraska and Kansas, and fragments of apparently two species of Oaks (*Dryophyllum*), which cannot be determined and described, the borders of the leaves being mostly destroyed and the nervation undiscernible. From a higher station of the same locality, a few specimens have, among undeterminable fragments, the two following species, for which, as yet, I find no relative form in the Cretaceous flora of the Dakota group, and none either in that of the Lower Lignitic.

30. DRYOPHYLLUM (QUERCUS) SALICIFOLIUM, *sp. nov.*

Leaf linear-lanceolate, rounded and narrowed to the base (broken), slightly curved to one side; borders acutely denticulate, with small teeth turned outward in the lower part and upward in the upper part of the leaf; substance rather membranaceous than coreaceous; lateral veins close, twelve pairs in a space less than five centimeters, slightly curving in passing up to the borders in an angle of divergence of forty degrees, either entering the teeth by their end, and branching under the teeth, the divisions following the borders, or curving in festoons along the borders, especially in the upper part of the leaf, and sending up a short branch into each tooth.

The ramification is that of this genus; the areolation is not distinct; in the upper part only the nervilles, in right angle to the veins, appear ramified in the same way, ending in square or polygonal areolæ.

Of the species of *Dryophyllum* published as yet, the only one comparable to this, and indeed closely allied, at least by its smallest leaves, is *D. subcretaceum*, Sap., of the Lower Eocene flora of Sezane.

31. ILEX STRANGULATA, *sp. nov.*

Leaf thick, coriaceous, with a rugose surface, narrow, panduriform, or strangled in the middle to a large tooth or small acute lobe, attenuated, entire, and rounded to the petiole; upper part enlarged, oval-pointed, with borders irregularly and distantly denticulate; secondary veins open, nearly at a right angle, but irregular in direction, angle of divergence, and distribution; curving close and along the borders, which they follow in double festoons, entering the teeth by branchlets; areolation small, square or polygonal.

The thick texture of this leaf is marked by its rugose surface obliterating the areolation, except in some places where the epidermis is destroyed. By its peculiar form this leaf is without distinct affinity with any species known to me; but the mode of irregular division, the thick texture, and the nervation in all its details refer it to the genus *Ilex*. Even our common Holly (*Ilex opaca*) has often deformed leaves, which present peculiar deviations of the original type.

These two species, without any positive relation of character with any described species of the Cretaceous or of the Tertiary, seem rather referable to Cretaceous age by a kind of general affinity with the leaves of the upper stage of the Cretaceous of New Jersey. Indeed, the two groups which have till now been explored in this State for fossil leaves present, by the lithology and the station, a striking likeness with what is seen in the stratification, the composition and the plants of the formations referred above and reported by Mr. Holmes. The lower group of New Jersey has coarse, sandy, white, or reddish shale as compounds of the beds, wherein the plants are embedded in profusion. These represent, always in fragmentary specimens, species either analogous or identical to those of the Dakota group. *Magnolia alternans* especially is in the collection of the Geological Survey of New Jersey upon a large number of specimens.* The upper group, on the contrary, has but a single species identical with those of the lower group, though the intervening space is not more than one hundred feet. All the types of this upper group are without analogy with those of the lower, and the specimens also are of a soft clay, where the characters of the leaves are far better preserved.

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* By the kindness of Dr. George H. Cook, the director of the Geological Survey of New Jersey, I had the privilege of a full and comparative examination of the numerous specimens of this collection.

Among the species of the Upper Cretaceous, one is apparently closely allied to the *Dryophyllum* of Mr. Holmes's specimens.* Mr. Holmes, who is preparing a report on the geology of the country where the specimens were found, refers the strata to the Cretaceous formation.

To my regret, I have had here to condense in a few sentences the descriptions of the new species and the remarks suggested by their examination. The light which they throw upon the general character of the Cretaceous flora has been merely noticed; and striking as may appear the elegance, the size, and the multiplicity of their forms, they had to be passed without records, as written descriptions are inadequate to give even a feeble representation of them. The study of these fossil plants impresses upon the mind the evidence of the richness of a flora which seems to be recent, even to belong to our present time by some of its predominant types, and which, nevertheless, represents the vegetation of an epoch so old that, at its beginning, the annals of geology have not yet any records of the appearence of dicotyledonous leaves. This flora, therefore, bears in it something of antique and venerable. It speaks to the mind and excites the imagination. In presence of its display, the query stands as an unsolved and alluring problem:—Where from and how have originated these multiple and admirable types of the Cretaceous flora, mostly representatives of dicotyledonous species?

COLUMBUS, OHIO, *November* 14, 1875.

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* These specimens were received after my return from New Jersey. I have had no opportunity of comparing them as yet, and merely speak from impression and from the description in my notes.

NOTES ON THE LIGNITIC GROUP OF EASTERN COLORADO AND PORTIONS OF WYOMING.

By F. V. Hayden.

The difference of opinion that has arisen in regard to the age of what I have hitherto called the Lignitic group in the West, caused me, during the past summer, to examine again the old areas in part, especially along the eastern slope of the Rocky Mountains in Colorado. The principal object I had in view was to determine as carefully as possible the stratigraphical relations of the coal-strata with the purely marine beds below. During the summer, I traced, with much care, the junction of these groups from Cañon City northward to Cheyenne on the Union Pacific Railroad, and thence along the railroad westward to Green River. As the largest development of the Lignitic group occurs in the vicinity of the railroad in Western Wyoming and Eastern Utah, it seemed important that this region should receive as much attention as possible.

We may state here in general terms that along the eastern base of the Rocky Mountains in Colorado, from the Raton Hills north to Cheyenne, there are no strictly marine coal-beds, and it is probable that they are all of brackish-water origin. As the entire thickness of this group in Eastern Colorado is estimated at about 3,000 feet, some of the upper beds may yet be found to contain well-marked fresh-water shells, but up to this time none have been reported as known from this entire area. The brackish-water shells have come for the most part from the lower beds.

We may consider for a moment the relations of the Cañon City group to the underlying Cretaceous series. We find near the base of the mountains, near Cañon City, on the Arkansas River, a fine development of the entire series of the Cretaceous, from the Dakota group to the summit of the Fox Hills group. No. 3, or the Niobrara group, is especially well shown in the uplifted ridges near the base of the mountains around Cañon City, and along the Arkansas River between Cañon City and Pueblo. For a distance of about ten miles below Cañon City, on the river, Nos. 4 and 5 are quite distinct; No. 4, composed of dark shaly clay, gradually passing up into a yellow arenaceous clay, and finally a laminated sandstone and clay to the lower sandstones of the coal group. If we follow up the dry beds of the little branches which lead into the Arkansas River from the coal area, we can note very distinctly the gradual change in the character of the sediments, showing the approach of shallow water and dry land. There are about 300 feet of the peculiar laminated sands, clays, and sandstones, largely concretionary, sometimes with layers of massive sandstone 15 to 30 feet thick, then thinning out or disappearing altogether, and a loose arenaceous clay taking their place. On this intermediate series of strata, an irregular bed of sandstone rests, varying from 50 to 200 feet in thickness, which we regard as the lowest bed of the Lignitic group. In this sandstone are

quite abundant vegetable forms, and at different localities one to three thin seams of coal. Immediately over this sandstone occurs the best workable bed of coal yet known in this basin. This lower sandstone may be regarded as the horizon between the coal group and the Cretaceous from Raton Hills far north to Denver and probably farther. In the laminated sandstones and arenaceous clay below the lower sandstone of the coal group for 200 to 300 feet, I searched in vain for any trace of organic remains. Mr. J. N. Clark, a mining-engineer, for several years in charge of the coal interests of the Denver and Rio Grande Railroad, informed me that he had examined the entire country from Cañon City to the Raton Hills, and that he had never found a marine fossil within 200 feet of the first coal-bed. No fossils but plants have yet been found in the Cañon City group.

The Raton Hills come within the area assigned to Dr. F. M. Endlich, assistant geologist, for geological examinations during the season of 1875, and I requested him to give special attention to the relations of the coal-strata to the underlying beds. He reports an unconformability extending along the base of the mountains for many miles. This fact has not, to my knowledge, been previously observed. He says:—

"Underlying the coal-bearing strata, we find older formations, the youngest of which is the Cretaceous. As the divisions of this formation differ widely from those observed farther north, and a discussion thereof would be out of place here, I will merely state that I regard these strata as Cretaceous, in which I have found unmistakable invertebrate fossils which are acknowledged to belong to that geological period. Overlying these strata unconformably, although the unconformability is very much obscured at many places, the coal-bearing series of sandstones and shales begins. About 500 feet below the lowest coal-bed, I found the highest Cretaceous fossils. All the intermediate strata yielded no paleontological evidence whatever. A number of coal-beds, varying in thickness in different localities, occur, separated from each other by sandstones and shales. At Trinidad, the Lignitic, or coal-bearing group, reaches a thickness of about 2,600 feet, containing a large number of coal-beds and seams. As the development of the formation is very typical at that locality, I have designated it as the 'Trinidad Lignitic group.'

"Taking into consideration the stratigraphical relation, the absence of fossils that might weaken this evidence, and the observations made upon the parallel group farther west, as well as its sharply-defined characteristics, I have come to the conclusion that it certainly cannot correctly be classed with the Cretaceous formation. As I am not supplied with sufficient proof, based upon paleontological evidence, to regard the Lignitic group as being of Tertiary age, I assign to it an intermediate position, between Cretaceous and Tertiary, showing, however, more affinities to the latter than to the former."

The Lignitic group is entirely absent from the Arkansas River north to Colorado Springs. Passing eastward over the rolling plain from Colorado Springs, we gradually rise about 800 feet within a distance of nine miles. The country is underlaid with Nos. 4 and 5. At one locality, the characteristic fossils of No. 5 are very abundant and of considerable variety. The usual calcareous concretions are scattered thickly over the surface, which, when broken, reveal an abundance of *Baculites ovatus; Inoceramus*, several species; *Scaphites Conradi; S. Cheyennsis;* and many others peculiar to No. 5, and some that are found abundant in No. 4. From No. 5 there is a barren interval of 300 to 400 feet, very similar to that at Cañon City. In the upper portion of these laminated

and rusty-brown concretionary sandstones, there is an abundance of impressions of sea-weeds, especially the *Halymenites major* of Lesquereux. The changes in the physical conditions, during this period of the deposition of the sediments, are admirably well shown by the different layers of the upper portion of the Fox Hills group up to the lower sandstones of the Lignitic.

The next most favorable locality for examination is near Platteville, on the Denver Pacific Railroad, about forty miles north of Denver. We have studied with much care the entire area embraced in the drainage of the Big and Little Thompson Creeks, Cache-à-la-Poudre, &c., so that it is hardly possible we can have been mistaken in our conclusions. On the west side of the South Platte River, opposite Fort Saint Vrain, are some rather high bluff hills, composed of the Upper Fox Hills group entirely. Here is an abundance of well-marked Cretaceous fossils, some of which have a wide geographical distribution, and are characteristic of the entire Fox Hills group, but which as a whole are peculiar and have not been known to occur previously in any other locality, except at the mouth of the Judith, on the Upper Missouri River. The entire mass of rocks in this region and on the Cache-à-la-Poudre show plainly the gradual approach from sediments deposited in deep, quiet waters to those laid down in shallow and turbulent seas. The shells in the Upper Fox Hills group were for the most part carried into eddies or restricted depressions, where they are found now, much broken and worn. There is no particular horizon in the group where the fossils may be found; but here and there a layer, from an inch to a foot in thickness and only a few feet in horizontal extent, is almost entirely made up of the shells. Of the fossils found together in the same beds *Nucula cancellata*, *N. planimarginata*, *Mactra Warrenana*, *M. formosa*, *Cardium speciosum*, *Tancredia Americana* are most abundant. A species of Ammonite, *A. lobatus*, which has a very extended vertical range in this group, is one of the last to disappear. It is found at this locality near the summit of the group. About five miles to the west of this point, on the opposte or east side of the South Platte, several shafts have been sunk in search of coal. The interval is mostly the alluvial bottom of the river, and therefore all the basis-rocks are concealed, but in this interval there were originally, without doubt, from one to two hundred feet of irregular layers of sand, sandstone, &c., probably barren of fossils. At any rate, the bed of sandstone, usually called the fucoidal sandstone, which usually lies at the basis of the Lignitic group, is wanting, or is obscured. The bed of coal, 2½ feet thick, was reached 52 feet below the surface. No fossils were found; but 300 yards southeast of the coal-shaft, the same parties sunk a second shaft, with the following results:

	Ft.	In.
1. Yellow sand and clay	42	0
2. Indurated clay or soapstone, with three inches of charred material, called "smut" by the miners	2	0
3. Clay	4	0
4. A layer of shells, *Anomia*, *Corbicula*, &c	3	6
5. Clay	0	6
6. Brown sand	1	6
7. Yellow and gray sandstone	10	..
8. Clay or soapstone	2	..
9. Coal	2	6
10. Clay-shale	0	4
11. Fine gray arenaceous clay	2	0
12. Clay near coal		

At a depth of 48 feet, the shaft passed through a bed of shells 3½ feet thick, with just clay enough to hold them loosely together. Two species were identical with fossils previously found by me in the clay, over a bed of coal, at Hallville, on the Union Pacific Railroad. That this bed of shells is above the marine sediments, and in brackish deposits, is evident. Nowhere has there been a strictly marine fossil discovered above or very near the lowest seam of coal.

About nine miles southeast of Cheyenne, there is a bed of coal, near the base of the Lignitic group, just over which, is a bed of oyster-shells three or four feet in thickness. The brackish character of the sediments of the lower portion of the Lignitic group is universal from British America, on the eastern slope of the Rocky Mountains, to New Mexico Near latitude 41°, a few miles south of the Union Pacific Railroad, on the east base of the mountains, the Lignitic group passes beneath the more modern White River group, and re-appears to the northward, about the line of parallel 43°. By examining the two geological maps, which I have long since published, the connection of the Colorado Lignitic with that of the Northwest will be at once apparent. It is not necessary to prolong these notes in this place, as the details of this subject have already been published in previous reports or will be fully elaborated hereafter. It re-mains now to deduce the following conclusions:—

1st. So far as Eastern Colorado is concerned, extending from Raton Hills to Cheyenne, we have no knowledge of any but brackish-water deposits of the age of the Lignitic group. Not a species of exclusively marine invertebrata passes above the lowest bed of coal. The sea-weed *Halymenites* is found in the Upper Fox Hills group and in the Lower Lignitic, but no special importance can be attached to this form as a test of the age of any group.

2d. It is evident that in many localities, and possibly throughout Eastern Colorado, a considerable portion of the Upper Fox Hills group is wanting. Sometimes the Lignitic group is deposited on No. 4 or No. 3 Cretaceous. Therefore, there is undoubtedly a conformable interrupted sequence; in other words, while the Lignitic group appears to conform to the underlying beds, there really are wanting hundreds, and perhaps thousands, of feet of strata which at some other locality in the West may exist.

3d. The fact that not a single form of animal or vegetable remains of strictly marine origin passes above the well-marked Cretaceous or Fox Hills group into the Lignitic, shows clearly that there is here a most important time-boundary; that not only stratigraphically, but biologically, one great epoch ends and another commences, each of which is, in every respect, distinct from the other.

4th. Inasmuch as the evidence is clear that the animal and vegetable forms below the base of the Lignitic group are strictly characteristic of the Cretaceous epoch, while in the Lignitic above, the vegetable life, with its great variety of forms, is regarded by our best authority, Professor Lesquereux, as purely Tertiary, and inasmuch as not one characteristic Cretaceous invertebrate has been found above the lowest bed of coal, but all have decided relations to Tertiary forms, we think we are warranted in regarding the Lignitic group of Eastern Colorado as of Eocene age.

In regard to the great coal-deposits of the interior of the continent, I desire to make some explanations in connection with the very valuable paper of Professor Lesquereux, which precedes this. During the past season, while endeavoring to gather materials to aid in settling the vexed problem of the age of these coal-deposits, after having examined with

as much care as the time would permit the line of junction in Eastern Colorado, I spent some days along the Union Pacific Railroad as far as the station at Green River. Having studied the geology of this portion of the West from Cheyenne to Great Salt Lake more or less since 1868, I became convinced that the region where this problem is to be settled lies in the interior of the West, in Western Wyoming and Eastern Utah, and so stated in my annual report for 1873.* It is here that the continuity will be found to be more complete than in any other portion of the West.

In Bulletin No. 2, first series, I gave a brief account of my investigations of the Lignitic group and the reasons that led me to consider it entirely of Tertiary age. Having explored it for over twenty years in the Northwest, where it is nearly all of fresh-water origin, having traced it with much care from latitude 49° southward to New Mexico, through nearly twelve degrees of latitude, and over an area of from one hundred to one hundred and fifty thousand square miles, where the evidence, either directly or indirectly, leaned to the Tertiary age of the group, I was led to the opinion that it formed a separate group, which was brackish-water at base and gradually passed up without interruption into the beds of purely fresh-water origin. Wherever fossil plants were discovered to any extent in its southern extension, species were identified as the same with those so abundant on the Upper Missouri. During the summer of 1868, I made a careful exploration of the coal-beds at Coalville, Utah, and at Bear River on the Union Pacific Railroad, when I saw for the first time the unmistakable proof that the coal-beds extended down into the Cretaceous series. At Bear River, near the west line of Wyoming, there was an abundance of well-marked Cretaceous fossils above and below the most important beds of coal. At Coalville, the workable bed of coal seemed to be far down into the Cretaceous. In the Proceedings of the American Philosophical Society at Philadelphia, February 19, 1869, page 48, I published a brief account of my examinations.

As far back as 1853, I had known of the existence of a seam of coal in the Dakota group, and from time to time traces have been found even in the Fort Benton group above; but that coal-beds extended all the way from the Jurassic through all the divisions of the Cretaceous, up to the summit of the Lignitic group, was not known to me. The discoveries of various geologists in the interior of the continent, especially in New Mexico, Arizona, and Utah, show this to be the case. Mr. Holmes and Dr. Endlich, assistant geologists with this survey, have found in Southern and Southeastern Colorado, during the past season, heavy beds of coal all through the Cretaceous groups from the base up. These coal-beds were observed during the summer of 1874 by members of the survey near the boundary-lines between Colorado, New Mexico, and Arizona, with an abundance of Cretaceous fossils above and below the coal-beds.

In Bulletin No. 2, first series, dated April, 9, 1874, I made this statement:—"As we go southward into Southern Utah, New Mexico, and Arizona, the greater portion of the coal-beds are in rocks of undoubted Cretaceous age. It seems conclusive therefore that the Lignitic group began in the Cretaceous period in the marine seas, and continued on upward, through the brackish-water times, into the purely fresh-water deposits." It is plain, therefore, that much of the difference of opinion about these deposits among field geologists is like the story of the shield. Those who have worked from the south and southwest toward the north have been

* See Annual Report for 1873, page 26.

thoroughly impressed with the Cretaceous age of these beds, while those who have studied them from the north and northwest toward the interior basin, received their first impressions that they were of Tertiary age. We now see that, taking a view of the entire West, the coal does not seem to be confined to any period, but even extends down into the Jurassic. Dr. Newberry, as far back as 1859, discovered coal in beds of undoubtedly Jurassic age in Arizona, as his section of the strata near the old Moquis villages would indicate.

If it is true that, taking into view the entire Lignitic area of our Western Territories, the coal-beds are continuous in every division, from the Jurassic to the summit of the Upper Lignitic, we might make this general division: 1st. Lower Lignitic group, including all the Lignitic deposits of marine origin; 2d. Middle Lignitic, embracing all deposits of brackish-water origin; 3d. Upper Lignitic, including all beds of purely fresh-water origin. In my opinion, the first division would include all beds to the summit of the true Cretaceous; the Middle Lignitic embraces my Transition series, or, if they are not admitted by geologists, I would insist upon their Lower Tertiary age. The Upper Lignitic, or fresh-water deposits, are of unquestioned Tertiary age. The details upon which these opinions are founded have been printed in my former reports, and cannot be repeated here without rendering this article too long.

On the west side of the Laramie Mountains, in the Laramie Plains, the Lignitic group re-appears to the westward. It is well shown at Rock Creek, on the east side of the Medicine Bow range, and is again well developed at Carbon, on the Union Pacific Railroad, where the coal has been very extensively wrought. Tracing the underlying formations from the west base of the Laramie range westward, across the plains, we find the full series of the Cretaceous groups gradually overlapping each other, and, before reaching Rock Creek, the lower beds of the Lignitic group extending over the Cretaceous beds, and corresponding with the same group on the east side of the Laramie Mountains.

The lithological characters, the fossils, and the relations of the group to the main beds below are so similar that I have inferred that all these beds once extended without interruption across the area now occupied by the mountain-range, and I still believe this generalization to be true. It is quite possible that some of the loftier ranges, as those of which Long's Peak and Pike's Peak form a part, were outlined far back in the past; but many of the minor ranges were undoubtedly elevated at a comparatively modern period.

As we proceed westward, there seems to have been an enormous thickening of the sediments, particularly during the Cretaceous and Tertiary periods. Commencing near the point where the Union Pacific Railroad crosses the North Platte, or about meridian of 107°, far west and south into the great interior basin, the aggregate thickness of the Cretaceous and Upper Lignitic (not including the fresh-water basins) must be at least 12,000 feet. As we reach the interior basin, all the formations known in that region have attained an enormous thickness, so that Mr. Clarence King regards the aggregate thickness of the sedimentary rocks in Utah at 56,000 feet; while in the immediate vicinity of the eastern division of the Rocky Mountains, the entire thickness of the sedimentary deposits cannot be one-third that amount. It is in the immediate valley of the Colorado, in Western New Mexico and Arizona, in the great basin between the Sierra and the Wasatch Mountains, where the principal thickening of these formations occurs. In such cases, their external characters change much, and the variety and quantity of the organic remains diminish to a great extent. Coarse conglomerates

and sandstones may be said to characterize to a marked degree the beds from the lowest Silurian to the summit of the Cretaceous. In the Northwest, the Cretaceous series have been separated into five well-marked groups, made up mostly of sediments deposited in quiet waters, containing in various localities an astonishing quantity as well as a great variety of beautifully-preserved fossils. No portion of our present seas can have a greater variety or abundance of molluscous forms than are now exposed in long belts, or zones, across the Cretaceous area on the Upper Missouri; but, as we advance southward from the Upper Missouri, the typical characters of the Cretaceous divisions are gradually lost, so that in Colorado they are not well defined. In the interior basin, they are not well defined, and, had they been studied to any extent there, previous to their examination on the Upper Missouri, it is doubtful if any other classification than Upper, Middle and Lower Cretaceous would have been given.

Between Rock Springs and Salt Wells stations, on the Union Pacific Railroad, there is an interesting anticlinal valley that may aid in throwing some light on the structure of this region. This anticlinal was first noticed and described by me in my Annual Report for 1870, page 171. I have examined it several times since, but have had no opportunity of following this anticlinal north and south of the railroad. In this way, the problem could be solved; for to the west of this anticlinal valley there is a series of the coal group from the well-defined Cretaceous up to the Green River group, while to the east the series can be studied to the summit of the Washakie group. In the anticlinal valley about Salt Wells station, and west of it, the characteristic clays of No. 4 Cretaceous are well shown, and reach a thickness of at least three hundred feet. Tracing this bed upward through the gradual changes to the sands and laminated sandstones of No. 5, I found, immediately beneath the laminated sandstone, numerous rusty calcareous concretions, full of fossils, quite characteristic of Nos. 4 and 5, *Baculites*, *Scaphites*, and *Inoceramus*. Having thus fixed a horizon, I endeavored to follow it up. Looking toward the west from Salt Wells station, a long series of bluffs can be seen on either side, composed of the shales of No. 4, holding so far as the eye can determine a horizontal position; but facing to the east, on either hand far south and north, a series of high, pointed bluffs extend, as far as the eye can reach, underlaid by No. 4, but capped with No. 5, and inclining about northeast at an angle of 5° to 15°, generally with an average dip of 10° to 12°. This inclination continues far eastward until the marine and brackish-water beds pass beneath the fresh-water strata of the Washakie, near Bitter Creek station. Above No. 4, there are about twelve hundred feet of laminated sandstones and arenaceous clays; the layers of sandstone becoming thicker and more massive toward the summit. This group undoubtedly represents No. 5, greatly thickened and somewhat changed in its external features. Above No. 5, and distinctly marked, is an extensive group of irregular-bedded and somewhat variegated sandstones, with intervals of sand and clay, mostly yellow, gray, and brown in color, extending to Point of Rocks. The entire series I estimated at about one thousand feet in thickness; but it would have required a more extended examination north and south of the road to have determined this with precision. Above and below Point of Rocks station, there is a thick bed of grayish-brown sandstone, which at once arrests the eye from its remarkable structure. It is shown along the railroad east and west of Point of Rocks station for several miles, is very variable in thickness, sometimes reaching 250 feet, and forming a massive though rugged bluff wall. The

proofs of deposition in turbulent waters are most remarkable, and the sediments are quite variable, though seldom so coarse as to become a conglomerate, varying from a rather fine sandstone to a pudding-stone. In this bed of sandstone are many irregular seams of indurated clay, sometimes simply filling small pockets or thin seams, extending only a few feet horizontally. It was in one of these seams of clay, about four feet thick, near the summit of the bed of sandstone, that a portion of the plants described in the preceding paper by Mr. Lesquereux were found. This sandstone appears to hold a position beneath all the workable beds of coal in this region, and from its thickness and massiveness forms a marked horizon. It is full of holes, cavities in some instances so large as to be called caves, worn out by the water which has trickled down from the top, the soft clay portions washing out most readily, so that the face of the rocks is often very rugged, presenting a most fantastic appearance. Sometimes the rock is literally honey-combed. The layers of deposition are so irregular that a mass in the center of the bed of sandstone, twenty or thirty feet thick in the middle, tapers to a point at each end within a horizontal distance of one hundred feet. Immediately above this sandstone at this locality are several beds of coal, four to six feet in thickness, and above and below these beds of coal are great quantities of oysters of several varieties and a species of *Corbicula*. It will be observed that everywhere the genus *Ostrea*, and in many instances *Anomia*, extend up into the brackish-water beds, and that even on the Upper Missouri, where these Lignitic beds were first discovered and pronounced to be of Miocene age, *Ostrea* and other brackish-water forms of *Mollusca* were found in the lowest strata. The group of plants described by Lesquereux from this sandstone are, so far as I know, from the lowest horizon in the series in which plants have been found up to this time. As Lesquereux remarks, the plants must represent a horizon very near the true Cretaceous beds, inasmuch as several of the species have strong Cretaceous affinities. At Rock Springs not a plant was found by me, and I cannot not ascertain that any one else has observed any at this locality. A species of *Corbicula* was rather abundant in the clay over the workable bed of coal.

It is not my purpose to present any details of the season's work in these notes. They are intended to be rather explanatory of my former views and the views I hold at present in regard to the important problem—the age of the Lignitic group in the West. So far as sections are concerned, as well as a most careful and accurate study of the formations from Bitter Creek to Coalville, the very detailed and interesting reports of Mr. F. B. Meek and H. M. Bannister in the Annual Report of the Survey for 1872 may be consulted.

With our present knowledge, we may separate the Lignitic beds, above what is usually understood as the Cretaceous Fox Hills group, into three divisions: 1st. The strictly marine strata, like those bearing coal at Bear River and Coalville; 2d. The mixed or brackish-water beds; 3d. The purely fresh-water strata, of which the upper portion of the Lignitic group of the Northwest is an excellent example. The first group contains abundant well-marked Cretaceous forms; yet even in this division, the physical changes which we find at later date were foreshadowed by the mingling of a few brackish-water species. The genus *Inoceramus*, which has always been relied upon as strong proof of the Cretaceous age of beds in which it occurs, is found both at Bear River and Coalville in great abundance.

Reaching a certain horizon, we gradually approach a second group of

beds, in which are found, in some localities, in seams varying from a few inches to several feet in thickness, made up almost entirely of different species of *Ostrea*, and mingled with them are a few well-known brackish-water forms. All the forms of *Mollusca* akin to those known in this group flourish in the brackish waters of our day.

Passing upwards, we gradually come to a great thickness of strata in which fresh-water Mollusks predominate. A careful study of the entire Upper Lignitic group from the bottom of the first division to the summit of the third, extended over the entire area of the West, would doubtless show no abrupt physical break in the series of molluscous life, but the marine and brackish-water forms gradually drop out of existence as the fresh waters slowly predominate, until only fresh-water forms are found. From the first appearance of the vegetable life, many forms appear which have a very extended vertical as well as horizontal range geographically. Now the question would arise as to where the line should be drawn between the Cretaceous and Tertiary formations. The stratigrapher may have much to do with this; for, if done at all, it must be drawn mostly on his testimony. That there may be faults or breaks in the series is quite possible, inasmuch as there must have been continued alternations or oscillations of land and water throughout 8,000 or 10,000 feet of strata, and, therefore, would even a slight unconformability be sufficient to decide the line of demarkation? It may be said that there are brackish-water strata in formations of all ages; but it must be recollected that the brackish-water strata in the Lignitic group are not restricted to a limited locality, but are as extensive as the formation itself. They extend from British America to New Mexico, and it is only in groups of Tertiary age that we have such widely-extended fresh-water deposits. I must insist, therefore, that my series of transition, or beds of passage, be acknowledged as having a real existence until some evidence is presented to the contrary. In all portions of the divisions mentioned above, we find, 1st, a gradual dropping-out of the strictly marine; 2d, the same gradual disappearance of the brackish-water forms. The third or fresh-water division will doubtless be regarded by all geologists as of Tertiary age.

In reply to the statement that the term "Lignitic" is not applicable to any one group, from the fact that coal is found in all the formations from the Jurassic to the summit of the Tertiary, I will say that I am well aware of that fact. In the Annual Report of the Survey for 1870, page 59, I mention the occurrence of several thin seams of lignite as occurring in the Green River group, on Henry's Fork. Great quantities of fresh-water shells were also found in close proximity. In the Washakie group, which extends along the railroad from near Separation to Bitter Creek, forming the divide of the continent, there are several beds of impure lignite. Many fresh-water shells occur in this group, similar or identical with those found at the base of the Green River group near the mouth of Henry's Fork. I have no doubt, therefore, that the Washakie group extends on westward across the anticlinal, re-appearing at Green River near the mouth of Henry's Fork from beneath the Green River group.

In the summer of 1870, I traced with considerable care the vast thickness of strata which are revealed from the junction of Henry's Fork northward along the west bank of Green River, from the Cretaceous through the Lignitic group, and the western extension of the Washakie group up to the Green River shales, and in the report of that year a full account is given. Up to this time I do not find occasion to modify, to any great extent, the opinions therein expressed.

Throughout the Lignitic group proper, that is, the portion occurring above the Fox Hills group, I have never found any true nonconformity. That there may be in some places an interrupted sequence in the beds is quite possible, and I am inclined to think the top of the thick bed of sandstone near Point of Rocks is an example. That there have been many oscillations of the surface, that it has been alternately above and below water many times, may be inferred from the numerous coal-beds. In the aggregate, there could hardly have been any marked interruption in the sequence of the deposition, even up to the summits of the highest Tertiary, though between the Lignitic group and the more modern Tertiaries, as the Washakie, Green River, and other fresh-water groups, there is at this time a true nonconformity. We may conclude that during the marine Lignitic, the mountain-ranges were slowly rising above the sea-level, yet there was an almost universal sea. During the middle, or brackish-water period, there were huge inland lakes, to which the salt seas had access, thus rendering them brackish, and still the general elevation of the crust went on. Still later, these inland lakes were cut off from marine waters, and the deposition of the sediments went on through countless ages, and the mountains continued rising, and these sediments were deposited against their sides as a shore-line. If we could look beneath the horizontal strata of the Washakie group between Separation and Bitter Creek, or under the Bridger and Green River groups along the immediate line of the railroad, we might find localities where the sequence of the beds is not interrupted, and yet, in the immediate vicinity of the mountain-ranges, as the Uintah, for example, the modern fresh-water Tertiaries rest unconformably on the older rocks. The Bridger and Green River groups jut up against the sides of the Uintah range with a very slight inclination. The White River group, on the east side of the Rocky Mountains, shows the same style of unconformability, never inclining more than 5° to 10°, even where the underlying Lignitic beds dip at a much greater angle.

So far as the geology of the Rocky Mountain region is concerned, the doctrine of the uninterrupted sequence of events is a most important one. If we were perfectly familiar with the structure of every portion of our earth's crust, it is probable that somewhere we should find an uninterrupted sequence in the deposition of sediments from the oldest known sedimentary rocks up through all epochs to the present time. We should then have such a unity in the fabric that we would be unable to decide where one age began and another ended; and the terms Silurian, Devonian, &c., would only appear as relics of the imperfect knowledge of the past. It is the highest aim of the geologist to obliterate, as far as possible, these lines of demarkation; and if, in the far western regions, we can remove all trace of any chasms between the Cretaceous and the Tertiary epochs, we have made an immense advance toward the completion of the geological fabric. Again, the evidence in regard to the age of the group, derived from the numerous vegetable remains, has been almost entirely ignored by some geologists as worthless, and great stress laid on that obtained from the vertebrates. With all due respect for their opinions, I am confident the reverse is the true state of the case, and that the vertebrates are of little value as tests of the age of these formations. We have shown how readily the change from purely marine waters to brackish and fresh waters would necessarily and did destroy all traces of marine invertebrate life; yet, according to Professor Cope, Cretaceous vertebrates continued far upward into the fresh-water portions of the true Lignitic group of the Northwest. Not a single species, however, seems to be identical with any found in other portions of the

world; but the inference is drawn that they must be Cretaceous from their relationship. The vertebrates of the Lignitic period having great powers of locomotion, and being able to live on land as well as in the lakes and marshes of that time, and as we have shown that there was at no time any important catastrophe or physical changes sufficient to affect them, could well have prolonged their existence far up into the Lignitic group, carrying with them as an inheritance, their Cretaceous characters, so that the important statement of Professor Cope is founded in fact, that during this period a Cretaceous fauna was contemporaneous with a Tertiary flora, establishing an uninterrupted succession of life across what is regarded as one of the greatest breaks in geological time.

ON THE SUPPOSED ANCIENT OUTLET OF GREAT SALT LAKE.

By A. S. Packard, Jr.

While attached for a few weeks this summer to Hayden's United States Geological and Geographical Survey of the Territories, I learned from conversations with General P. E. Connor, late of the United States Army, and others, of the supposed existence of an old river-bed, which probably drained, in part at least, the lake which in Quaternary times formerly filled the Salt Lake Valley. I have been unable to find any reference to such an outlet in the report of Frémont, Stansbury, or Hayden. The following quotation, extracted by Professor Hayden from the second volume of the Pacific Railroad Reports, page 97, shows, on the contrary, that no outlet has been supposed to exist:—

"These banks are not peculiar to the vicinity of this lake of the basin, but were observed near the lakes in Franklin Valley, and will probably be found near other lakes, and in the numerous small basins which united form the Great Basin. They clearly seem to have been formed and left dry within a period so recent that it would seem impossible for the waters which formed them to have escaped into the sea, either by great convulsions opening passages for them, or by the gradual breaking-up of the distant shore (rim of the basin), thus draining them off without leaving abundant records of the escaping waters, as legible at least as the old shores they formed."

My object at the present moment is simply to call the attention of geologists and geographers to the facts stated by General Connor, suggested by railroad-surveys made in Southern Utah. An intelligent man who has lived for seven years on the shores of Salt Lake, and also Mr. J. E. Clayton, mining-engineer, of Salt Lake City, who has traveled much in Southern and Central Utah, have kindly given me confirmatory information regarding this ancient river-bed.

It appears also that there is a very general impression that such an outlet formerly existed and drained the waters of the lake into the Gulf of California or possibly into the Pacific Ocean emptying near San Diego.

General Connor, my original informant, has kindly indicated, on a map of Utah and adjoining regions lying southward, the course of this supposed river-bed. The rim of the present Salt Lake is lowest at Skull Valley, which opens into the lake at a point on the western side of the lake due west of the northern extremity of Antelope Island. The outlet is said to be somewhat over one hundred feet above the present level of the lake. The river-bed has been traced by railroad-surveyors for a distance of over one hundred miles, in a southerly direction, to the Sevier Lake Valley, passing west of Sevier Lake.

Beyond this, the course of the river-basin is purely conjectural; but the indications are that the river poured into the Colorado River near the confluence of the Muddy River and Rio Virgen. It is possible that it may

have had an independent outlet into the Dry Lake Basin, the valley of which is seventy feet below the present ocean-level, and situated north of east of San Diego. From here it may have emptied into the head of the Gulf of California, or turned westward and sought the Pacific Ocean at or somewhere near the bay of San Diego.

These suggestions made by practical railroad-engineers are offered for the consideration of geologists. The writer has not observed personally any facts bearing on the subject. Granting, however, that the lake was thus drained, and in view of the fact that it is one of the few lakes in the West that has at present no outlet, it seems reasonable to suppose that the lake was a fresh-water inland sea while above this level, and that after it ceased to have an outlet the waters decreased and became salt partly through the agency of evaporation and the probable supply of saline matter from salt-springs around the border of the lake, and possibly from salt-deposits in the surrounding rocks and soil.

From these facts, it is not difficult to understand why the Great Salt Lake became a dead sea, or gigantic brine-pool, while Utah Lake, with an outlet, the Jordan River, remains a fresh-water lake. I was unable to ascertain the exact height above the present level of the lake of this ancient river-bed, but was told it was one hundred feet or over.

DEPARTMENT OF THE INTERIOR.

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OF

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DEPARTMENT OF THE INTERIOR.

UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES.

F. V. HAYDEN, U. S. GEOLOGIST-IN-CHARGE.

I.—AN ACCOUNT OF THE VARIOUS PUBLICATIONS RELATING TO THE TRAVELS OF LEWIS AND CLARKE, WITH A COMMENTARY ON THE ZOOLOGICAL RESULTS OF THEIR EXPEDITION.

BY DR. ELLIOTT COUES, U. S. A.

II.—NOTICE OF A VERY LARGE GONIATITE FROM EASTERN KANSAS.

BY F. B. MEEK.

III.—FOSSIL ORTHOPTERA FROM THE ROCKY MOUNTAIN TERTIARIES.

BY SAMUEL H. SCUDDER.

IV.—STUDIES OF THE AMERICAN FALCONIDÆ.

BY ROBERT RIDGWAY.

MONOGRAPH OF THE POLYBORI.

WASHINGTON, February 8, 1876.

AN ACCOUNT OF THE VARIOUS PUBLICATIONS RELATING TO THE TRAVELS OF LEWIS AND CLARKE, WITH A COMMENTARY ON THE ZOOLOGICAL RESULTS OF THEIR EXPEDITION.

By Dr. Elliott Coues, U. S. A.

PART I.—BIBLIOGRAPHICAL.

Publication of the results of this memorable undertaking was attended by the untoward circumstances that neither of the persons chiefly concerned became the ostensible author, and that, pending the preparation of their unfinished MSS. for the press at other hands, two separate sources of incomplete information respecting their travels became available. These were eagerly seized by publishers, who appreciated the lively and general interest which the intrepid explorers had awakened. The result has been the appearance of a number of books of the most diversified character, all of which, nevertheless, purport to be, in one way or another, the "Narrative," "Travels," or "Journey," of "Lewis and Clarke," though the claim of the majority of them to be so considered rests upon slight foundation. The bibliography of the subject, if not more extensive than would be expected, is in a confused state, and quotation of Lewis and Clarke has become impossible without explicit reference to some particular edition.

Having frequent occasion to consult the work in its bearing upon the zoology of the West, a subject now undergoing searching scrutiny at many able hands, I have been led to examine the matter with some care, and with the result here presented, which, it is hoped, may tend to place the subject in clearer light. I have examined most of the editions, and am able to give the titles of others not seen.

Probably the best account extant of these books is that contained in Thomas W. Field's "An Essay towards an Indian Bibliography," &c. (New York, 8vo, 1873.) The author, however, includes none of the foreign versions, and omits several others I have seen.—And here I would add that, in the arid wilderness of titles, often imperfect if not erroneous, which compose the average catalogues of books, it is refreshing to meet with such a model piece of bibliography as this masterly work of Mr. Field's.

All of the numerous editions and versions of "Lewis and Clarke" which I have seen or heard of may be traced to one or another of three sources, namely:—

I. The *Jefferson* Message and Accompanying Documents. (1806.)
II. The *Gass* Journal. (1807.)
III. The *Biddle-Allen* History of the Expedition. (1814.)

Of these, the last named alone is the complete, authentic, and authorized account, prepared from the original MSS. of Lewis and Clarke. The Gass Journal is a perfectly authentic narrative of the journey, by a non-commissioned officer attached to the party, but is *not* a "Lewis and Clarke." From Jefferson's official communication, which is, of course, exactly what it purports to be, have sprung a number of books to which the names of Lewis and Clarke are more or less prominently attached; all of which are, nevertheless, spurious as far as they claim to

be narratives of the expedition. These three classes of books will be successively considered.

I.—THE JEFFERSON PRODROME AND THE APOCRYPHA.

On the 19th of February, 1806, the expedition being then still in progress, President Jefferson addressed to Congress a communication, entitled as follows:—

[1806.] *Message* | *from the* | *President of the United States* | *communicating* | *Discoveries* | *made in exploring* | *the Missouri, Red River and Washita,* | *by* | *Captains Lewis and Clark, Doctor Sibley,* | *and Mr. Dunbar;* | *with* | *a Statistical Account* | *of the* | *Countries adjacent.* | — | *February* 19, 1806. | *Read, and ordered to lie on the table.* | — | *City of Washington:* | *A. & G. Way, printers.* | . . . | 1806.
8vo. pp. 1–171, 3 *l.* (*State Papers.*)

It is necessary to examine this article closely, in order to see how the apocrypha depend upon it. The "message" itself is a curt official letter. Next comes a semi-official letter to the President from Captain Lewis, dated Fort Mandan, April 17, 1805, giving a progress-report of the expedition at that date, &c. "A Statistical View of the Indian Nations inhabiting the Territory of Louisiana* and the Countries Adjacent to its Northern and Western Boundaries," by Captain Lewis, is the second of the accompanying documents; an elaborate set of statistics of various tribes, with miscellaneous particulars. It is these last, patched together, that constitute the "Statistical View" printed in the various apocrypha. The third paper is Dr. Sibley's "Historical Sketches of the Several Indian Tribes in Louisiana, south of the Arkansa River, and between the Mississippi and the River Grand." These "Sketches" are transferred bodily, with some abridgment and mutilation, to the apocrypha. The fourth article consists of "Observations made in a Voyage commencing at St. Catharine's Landing, on the East Bank of the Mississippi, proceeding downwards to the Mouth of Red River, and from thence ascending that River, the Black River, and the Washita River . . . . from the Journals of William C. Dunbar, Esq., and Dr. Hunter." With omission of some meteorological tables appended to the original, this document, like Dr. Sibley's, is introduced into the apocrypha with little change.

The President's message and accompanying documents also appear, without the same caption, and otherwise modified in form, in other official archives of Congress. The same year, 1806, it was again reprinted in New York, as a pamphlet, which I have not seen; the title of which, nearly identical with that of the original, except as relates to the imprint, is kindly furnished by Mr. F. B. Perkins, of the Boston Public Library, as follows:—

[1806.] *Message* | *from the* | *President of the United States,* | *communicating* | *Discoveries* | *made in exploring the* | *Missouri, Red River and Washita,* | *by* | *Captains Lewis and Clarke, Doctor Sibley* | *and Mr. Dunbar;* | *with* | *a Statistical Account* | *of the* | *Countries adjacent.* | — | *Read in Congress, February* 19, 1806. | — | *New-York:* | *Printed by Hopkins and Seymour,* | *and sold by G. F. Hopkins, No.* 118, *Pearl-street.* | — | 1806.
One vol. 8vo, pp. 128+1 *folded l. not paged.*

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* On Captain Lewis's map, the name "Louisiana" lies across the present northern boundary of the United States.

From this official *prodrome*,* the earliest available source of much-desired information, books quickly sprung, which, however modified in title or in substance with successive editions, are essentially the same. These are mostly anonymous as to author, compiler, or editor, being clearly publishers' enterprises; and, though containing matter of intrinsic merit and interest for the time, they are all, as just stated, spurious in as far as they pretend to be the narrative of Lewis and Clarke, and therefore properly to be styled the *apocrypha*. These books consist chiefly of accounts of the Indians, variously compiled from the three sources indicated in the President's message. The titles and captions of some of them are well contrived to make them appear as the work of our authors. The apocrypha were not wholly superseded by the appearance of the genuine narrative in 1814, but continued to be published at least until 1840, though they are now becoming scarce and are seldom if ever quoted. The earliest one of them I have seen (one which, however, purports to be no more than it really is) was printed in London the year following the President's message and accompanying documents, of which it is a literal reprint ("nearly an exact copy," says Field), under a modified title, as follows:—

[1807.] *Travels | in the | Interior Parts of America; | communicating | Discoveries | made in Exploring | the Missouri, Red River and Washita, | by | Captains Lewis and Clark, | Doctor Sibley, | and | Mr. Dunbar; | with | a statistical account | of the | Countries adjacent.* | — | *As laid before the Senate, | by the | President of the United States. | In February,* 1806, | *and never before published in Great Britan.* | — | *London: | Printed for Richard Phillips,* 6, *Bridge Street, | Blackfriars, | By J. G. Barnard,* 57, *Snow-hill.* | — | 1807.

8vo. pp. 1–116, *with a folding table. Forming a part, separately paged, of Vol. VI. of Phillips's "Collection of Modern and Contemporary Voyages," &c.*

Of this book, Field remarks, somewhat quaintly, "It is one of a series of travels published by Sir Richard Phillips, bookseller and baronet, who is the only example I recollect of that combination of trade and title."

Two years subsequently, in 1809, two editions of the apocrypha appeared simultaneously in England and America. To judge by their titles, and from what I can learn of the English one, they are very similar, if not identical. I do not know the inside history of these two anonymous books in their mutual relations, nor which has actual priority; but I should suppose that the English was taken from the American, just as the Rees edition of the authentic narrative was from the Biddle-Allen one. As transcribed by Rees, the title is somewhat abbreviated; the fuller title, as given by Field, is as follows:—

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* Among collateral publications bearing on the subject may be noticed the following State Paper—in some evidence against the proverbial ingratitude of republics:—

[1807.] "*Documents accompanying a Bill making compensation to Messieurs Lewis and Clarke; and their companions, presented the 23d January* 1807. *Washington: A. & G. Way.* 1807." *8vo. pp.* 1–8.

[Grants of land to the whole party. Captain Lewis was soon after made governor of "Louisiana"; Captain Clarke, general of Louisiana militia and agent for Indian affairs.]

[1809.] "*The Travels of Cap^ts Lewis and Clarke, from St. Louis, by way of the Missouri and Columbia rivers, to the Pacific Ocean; performed in the years* 1804, 1805, *and* 1806, *by order of the government of the United States, containing delineations of the manners, customs, religion, &c. of the Indians, compiled from Various Authentic Sources, and original Documents, and a Summary of the Statistical View of the Indian Nations, from the official communication of Meriwether Lewis. Illustrated with a Map of the Country, inhabited by the Western Tribes of Indians. 8vo, pp. ix and* 309. *London,* 1809."

This publication, which I have not seen, is said by Rees to contain "the principal part of Captain Lewis's Statistical View of the Indian Nations of Louisiana [*i. e.*, of the West at large], together with Dr. Sibley's Account of the Indians on the Arkansaw, &c., and Mr. Dunbar's and Dr. Hunter's Account of the Washita River." Mr. Rees continues: "As far as relates to Lewis and Clarke's Travels, this work is not, however, what it pretends to be, for it contains no further account of them than was given in the above message [*i. e.*, President Jefferson's], and some private letters of Captain Clarke, addressed to his friends before and after his return. But, in other respects, it is of considerable value, the other documents inserted in it being curious, and contained in no other English publication."

The corresponding American edition, in 12mo, of 1809, which is not noticed by Field, but of which I have several copies before me, is as follows:—

[1809.] *The | Travels | of | Capts. Lewis & Clarke, | by order of the | Government of the United States, | performed in the years* 1804, 1805, & 1806, | *being upwards of three thousand miles, from | St. Louis, by way of the Missouri, and | Columbia Rivers, to the | Pacifick Ocean: | Containing an Account of the Indian Tribes, who inhabit | the Western part of the Continent unexplored, | and unknown before. | With copious delineations of the manners, cus- | toms, religion, &c. of the Indians. | Compiled | From various authentic sources, and Documents. | To which is subjoined, | A Summary of the Statistical View of the Indian | Nations, from the Official Communication of | — | Meriwether Lewis. | — | Embellished with a Map of the Country inhabited by | the Western Tribes of Indians, and five Engravings | of Indian Chiefs. | — | Philadelphia: Published by Hubbard Lester. | . . . . |* 1809. | *Price* — 1 *dollar* 62½ *cts.* |

One vol., 12*mo, pp. i–xii,* 13–300, *pll.* 5, *map, and tail-piece (scroll and pen.)* (*Copyright dated April* 17, 1809.)

The composition of this wretched little meretricious compilation is of the most thoroughly motley character, showing that the art of bookmaking was highly developed at least as early as 1809. In the first place, the typography of the title-page is ingeniously so arranged as to make it appear, at first sight, that Meriwether Lewis is the author. The title-page is followed by Lester's copyright. Then comes the "recommendation" from President Jefferson, artfully twisted into a recommendation of the book itself. A mutilated version of Jefferson's

"message" succeeds. Then comes the compiler's introduction, consisting of some meditations on the value of geographical knowledge, and a statement, from some person unknown, of the commerce of the Missouri. The running-heads of the pages to p. 153 read, "New Travels among the Indians." This part of the book is meant to pass for Lewis and Clarke's narrative; the anonymous compiler audaciously opens with the now familiar "On the 14th of May, 1804, we embarked from St. Louis," &c.; but it is in no sense what it purports to be. Where the materials came from, I cannot make out; they were not in Jefferson's message and documents, and do not appear to be from Gass, and I do not know what other sources of supply were available at that date. But, at any rate, it is *not* Lewis and Clarke, though some private letters of the latter, doubtless authentic, are introduced (pp. 23–35). A fine snake story is brought in (pp. 39–40): the reptile "was in bulk half as large as a middle-sized man." From p. 119 to p. 153 is an account of the Knisteneaux and Chepewyan Indians, from the pen of A. Mackenzie. Then comes the "Statistical View," pp. 154–178; this is a mutilated compilation of parts of Captain Lewis's paper, furnished to the President. Similarly, the "Historical Sketches," which follow, pp. 179–204, are a mutilated abridgment of Dr. Sibley's paper. Pages 204–228 consist of an account of the origin of the Indians, by "an ingenious traveller." This part of the book likewise has no connection whatever with Lewis and Clarke. Thence to p. 292 are Mr. Dunbar's and Dr. Hunter's "Observations" on the Washita, &c. The volume closes with some anecdotes, one of which is the story of "Master Neddy," copied from William Buchan's "Domestic Medicine," and not having the most remote connection with anything that precedes. Yet this is the book which, with its several offspring, doubtless many thousand worthy American citizens and loyal British subjects have read for "Lewis and Clarke"—and, indeed, it is a very readable book.

We have next to notice two Baltimore editions of the apocrypha, published by Fisher. None of the regular editors of Lewis and Clarke allude to these books, nor are they represented in Field's bibliography. I have before me two editions, of 1812 and 1813; their titles are as follows:—

[1812.] *An* | *Interesting Account* | *of the* | *Voyages and Travels* | *of* | *Captains Lewis and Clark,* | *in the years* 1804, 1805, *and* 1806. | *Giving a faithful description of the river Missouri and* | *its source—of the various tribes of Indians through* | *which they passed—* | *manners and customs—soil—climate* | *—commerce—gold and silver mines—animal and vege-* | *table productions interspersed with very enter-* | *taining anecdotes, and a variety of other useful and* | *pleasing information remarkably calculated to de-* | *light and instruct the readers—to which is added a* | *complete dictionary of the Indian tongue.* | *By William Fisher, Esq.* | — | *Baltimore.* | *Printed by Anthony Miltenberger, For the purchasers.* | 1812.

One vol., 12*mo*, 2 *portraits*, *pp. v–xv*, 16–326.

[1813.] *An* | *Interesting Account* | *of the* | *Voyages and Travels* | *of* | *Captains Lewis and Clarke,* | *in the years* 1804–5, *&* 6. | *Giving a faithful description of the river Missouri and* | *its source—of the various tribes of Indians through* | *which they passed—manners and customs—soil* | *—climate—commerce—gold and silver* | *mines—animal and vegetable* | *productions.* | *Interspersed* | *With very entertaining anecdotes, and a variety*

of | *other useful and pleasing information, re-* | *markably calculated to delight and* | *instruct the readers.* | *To which is added* | *A complete Dictionary of the Indian tongue* | — | *by William Fisher, Esq.* | — | *Baltimore:* | *printed and published by P. Mauro,* | *No.* 10, *North Howard St.* | 1813.

One vol., 12 *mo, portraits?* pp. iii–xii,* 13–262, *with* 3 *full-page wood cuts.*

William Fisher, esq., must have been a bold man, and he may not have been a bad man too. Whereas the compiler, or editor, or whatever he may have been, of the editions of 1809 retired behind an anonym, William Fisher not only stole his production bodily, and gave it another name, but also formally announced himself as the author of the same; for the edition of 1812 is a literal reprint, as nearly as may be, of that of 1809—even to the snake story and Master Neddy. The edition of 1813 is nearly another reprint; the title reads substantially the same, though the typography of the title-page is entirely different. In this edition, Master Neddy is dropped. The edition is notable as the first of this series of apocrypha which was illustrated. The smiling faces of "Captains Lewis and Clarke, returned" greet us; we have a tragic scene of an Indian "destined to death" by the flames; a thrilling view of a man with a bear behind and a precipice in front, &c. William Fisher does not appear to have possessed the copyright of this production.

In the interval between 1813 and 1840 there may have been, and probably were, other editions of the apocrypha; but the following, published by Ells at Dayton, Ohio, 1840, is the only one I have seen or heard of:—

[1840.] *The* | *Journal* | *of* | *Lewis and Clarke,* | *to the Mouth of the Columbia River* | *beyond the Rocky Mountains.* | *In the years* 1804–5, *&* 6. | *Giving a faithful description of the River Missouri* | *and its source—of the various tribes of Indians* | *through which they passed—manners and cus-* | *toms—soil—climate—commerce—gold and* | *silver mines—animal and vegetable* | *productions, &c.* | *New Edition, with Notes.* | *Revised, corrected, and illustrated with numerous* | *wood cuts.* | *To which is added* | *a complete dictionary of the Indian tongue.* | — | *Dayton, O.* | *Published and sold by B. F. Ells.* | *John Wilson, printer* | . . . . | 1840.

One vol., 16*mo, pp. i–xii,* 13–240, *portraits of Lewis and of Clarke, and* 14 *other full-page woodcc.*

The advertisement of the "proprietor" of this edition says: "The great demand for the Journal of Lewis & Clarke, has induced the republication of the work, with the additions of extensive and interesting notes, and numerous illustrations on wood. We have divided the work into Chapters, with appropriate captions, corrected much that was erroneous in the Topography, and especially in the Nomenclature and Orthography of the Proper Names, and the Philological errors (of which there were many,) have been corrected, where it could be done, without too materially infringing the text." But this volume, aside from some changes in the general make-up, addition of table of contents, insertion of wood-cuts, and the minor points noted in the advertisement just quoted, is the same as its prototype of 1809, notwithstanding the notable modification of title, by which it attempts to lay still stronger claim to be the authentic "Narrative," and by which perhaps it acquired

*In the copy examined, whatever may have preceded the title-page is torn out.

an undeserved copyright. The running-heads of the pages, throughout the volume, are the words "Journal of Lewis & Clarke." The addition of "a complete dictionary of the Indian tongue," as per the title, is a false claim (as it was in Fisher's case), as this "dictionary" is simply the glossary of Knisteneaux words and phrases which was contained in the editions of 1809. The "notes" added would probably be called "extensive and interesting" only by the publisher. The volume closes with an "appendix," containing some irrelevant "anecdotes," not entirely the same as those of the 1809–1812–1813 editions; Master Neddy being replaced by a story about a "Great African Serpent, killed by Regulus the Roman General." The illustrations are most of them additional to any I have seen elsewhere; Captain Clarke still smiles on us, but his less fortunate companion looks as if he were really meditating suicide.

II.—THE GASS JOURNALS.

This publication is perfectly authentic, in the sense that it is exactly what it purports to be—a narrative of the expedition, by a known person who accompanied Lewis and Clarke, though it is not, nor does it pretend to be, the journal of his leaders. Patrick Gass was a sergeant of the command, and appears to have been an ignorant, intelligent, and observant person, who kept a diary of his own, in which events of the journey and their impressions upon the writer were recorded from day to day during the whole period. His general good character and the faithful and efficient service he rendered are formally certified by Captain Lewis. The Gass narrative is a plain, straightforward, and connected account. Paul Allen alludes to it, without mention of the writer's name, and with unnecessary depreciation, as the "least minute and valuable" of two journals, the other being kept by a brother sergeant, and, I think, never published. Thomas Rees speaks of it in a way more to my liking, as being "in general, sensible and judicious." It serves as a valuable check upon the narrative of Lewis and Clarke itself in the minutiæ of dates, names, places, &c., and on this account may not inaptly be termed a *concordance.*

Gass's work seems to have been entirely superseded by the publication of the regular narrative; at least, I know of no edition later than 1812. I learn altogether of five (and there was probably another) editions of this "concordance," namely: Pittsburgh, 12mo, 1807, and 8vo, 1808; London, 8vo, 1808; Philadelphia, 12mo, 1810 and 1812 (and French version, 1810?). Excepting the French, they only differ from each other in details of typography, and are virtually nothing more than reprints, though some of them are illustrated, the others not. The original edition is as follows:—

1807.] *A Journal | of the | Voyages and Travels | of a Corps of Discovery, | under the command of Capt. Lewis and Capt. | Clarke of the Army of the United States, | from | the mouth of the River Missouri through the | interior parts of North America | to the Pacific Ocean, | during the years* 1804, 1805, & 1806. | *Containing | An authentic relation of the most interesting transactions | during the expedition,—A description of the country,— | And an account of its inhabitants, soil, climate, curiosities | and vegetable and animal productions.* | — | *By Patrick Gass, | one of the persons employed on the expedition.* | — | *With geographical and explanatory notes | by the publisher.* | — | *[Copy-right*

secured according to law.] | *Pittsburgh,* | *printed by Zadok Cramer,* | *for David M'Keehan, Publisher and* | *proprietor.* . . . . 1807. |

One vol., 12*mo*, *pp. i–viii*, 9–262. (*No illustrations.*)

There appears to have been another Pittsburgh edition, in 8vo, probably of 1808; the one from which a London edition was reprinted. The title as given by Field differs only from that of the 12mo, 1807, in the punctuation. Field describes it as "8vo. pp. 381. Pittsburgh, printed for David McKeehan; London, reprinted for J. Budd, 1808."

The next edition I know of appeared in Philadelphia, in 1810, as follows:—

[1810.] *A* | *Journal* | *of the* | *Voyages and Travels* | *of a Corps of Discovery,* | *under the command of Capt. Lewis and Capt.* | *Clarke of the Army of the United States,* | *from* | *the mouth of the River Missouri through the* | *interior parts of North America,* | *to the Pacific Ocean,* | *During the Years* 1804, 1805 *and* 1806. | *Containing* | *an authentic relation of the most interesting transac-* | *tions during the expedition,—A description of* | *the country,—And an account of its inhabi-* | *tants, soil, climate, curiosities, and ve-* | *getable and animal productions.* | — | *By Patrick Gass,* | *one of the persons employed in the expedition.* | — | *With* | *geographical and explanatory notes.* | — | [*Copy-Right secured according to Law.*] | — | *Philadelphia:* | *Printed for Mathew Carey,* | *No.* 122, *Market-street.* | — | 1810.

One vol., 12*mo*, *pp. i–viii*, 9–262, *with* 6 *full-page wood cc.*

The title of this edition is substantially the same as that of the foregoing, though the arrangement of the title-page is quite different, as shown by the bars in the preceding paragraphs. The pagination is identical, and, in fact, the edition, as far as the text is concerned, is a mere re-issue, probably from the same plates, of the Pittsburgh 12mo of 1807; though the typography of pp. 9 and 11 is different. To this edition, however, are added six full-page wood-cuts, in which the figures of men, trees, and animals are notable rather for the mathematical regularity of their lines than for any approach to "curves of beauty."

This edition is said to have been re-issued at Philadelphia in 12mo, 1812. I have seen no copy bearing this date. The title, as quoted by Field, is substantially identical; the illustrations are continued. This is spoken of as the "fourth" edition; but if the London 8vo reprint of the Pittsburgh 8vo, 1808, be counted as one, then the Philadelphia 12mo of 1812 is at least the fifth, if not the sixth.

Before proceeding to the consideration of the regular authentic editions, I should notice a French version of a "Lewis and Clarke," known to me only by title, the date of which is given as 1810. Not having seen this book, I cannot say whether it is a version of the apocrypha or of the concordance. The major part of the title reads like the apocrypha, but the rest is more like Gass's Journal, of which, I suppose, this is a version. The title, as given by Quérard, is as follows:—

[1810.] "*Voyages des capitaines Lewis et Clarke, depuis l'embouchure du Missouri jusqu'à l'entrée de la Colombia, dans l'Océan Pacifique, fait dans les années* 1805–06, *par ordre du gouvernement des États-Unis, contenant le Journal des événements les plus remarquables du voyage, la de-*

scription des habitants, du sol, les productions animales et végétales, etc.; trad. en français par A.-J.-N. L. (Lallemant). Paris, A. Bertrand, 1810, *in*-8, *avec carte*, 6 *fr*."

III.—THE AUTHENTIC NARRATIVE.

[1814.] *History* | *of* | *The Expedition* | *under the command of* | *Captains Lewis and Clark*, | *to* | *the sources of the Missouri*, | *thence* | *across the Rocky Mountains* | *and down the* | *River Columbia to the Pacific Ocean.* | *Performed during the years* 1804–5–6. | *By order of the* | *Government of the United States.* | *Prepared for the press* | *by Paul Allen, Esquire.* | *In two Volumes.* | *Vol. I* [*II*]. | *Philadelphia:* | *Published by Bradford and Inskeep; and* | *Abm. H. Inskeep, Newyork.* | *J. Maxwell, Printer.* | 1814.

Two vols., 8*vo*. *Vol. I, pp. i–xxviii*, 1–470, *maps*. *Vol. II, pp. i–ix*, 1–522, *maps*. (> *Vol. II, Chap. VII*, "*A general description of the beasts, birds, and plants, &c. found by the party in this expedition*," *pp.* 148–201.)

The editor's preface sets forth (not too fully) the circumstances under which the authentic MSS. of the work were prepared for the press. It had been, it appears, Captain Lewis's design to edit his travels himself. He commenced the work, and was *en route* to Philadelphia to complete it when his intention was frustrated by his tragic death. The papers were then deposited, after considerable delay, in the hands of Nicholas Biddle, who immediately proceeded to collect and investigate all the materials within his reach. The sources of information are thus given by Paul Allen: "Of the incidents of each day during the expedition a minute journal was kept by Captain Lewis or Captain Clark, and sometimes by both, which was afterwards revised and enlarged at the different periods of leisure which occurred on the route. These were carefully perused in conjunction with Captain Clark himself, who was able from his own recollections of the journey, as well as from a constant residence in Louisiana since his return, to supply a great mass of explanations, and much additional information with regard to part of the route which has been more recently explored. Besides these, recourse was had to the manuscript journals kept by two of the sergeants, one of which, the least minute and valuable, has already been published.* That nothing might be wanting to the accuracy of these details, a very intelligent and active member of the party, Mr. George Shannon, was sent to contribute whatever his memory might add to this accumulated fund of information. From these copious materials the narrative was sketched nearly to its present form, when" circumstances caused the transfer of the unfinished MSS. and accompanying documents to another editor, namely, Paul Allen, under whose superintendence the narrative in its final shape was published. To it is prefixed a "Life of Captain Lewis," by President Jefferson, embodying a certified copy of the official instructions under which he acted.

Thomas W. Field is severe upon Paul Allen, in this style: "At this stage [*i. e.*, when Paul Allen undertook it] of the growth of the history Mr. Biddle from caprice, or business abstraction, abandoned its direc-

* The allusion is here to Gass's journal. It is a significant fact that no reference is made to the books I have styled the "apocrypha."

tion, when his literary structure was nearly or quite complete. It was thus left for the editor, (whom popular esteem has credited with the labor of forming the work,) only to obtain a sketch of the life of Captain Lewis from President Jefferson, and to place his name on the title page. All of this he states in the Preface, but neglects to name the industrious and judicious editor who wrought the work ready to his hand; yet emblazons his own name in the place of honor on the title." I do not undertake to defend Mr. Allen for suppressing Mr. Biddle's name, in doing which, as well as in refraining from mention of Gass, he evinces a desire to place himself in solitary prominence in connection with the great work; but he certainly gained the right, moral and legal, to appear as the preparer of the work for the press after Mr. Biddle, "from caprice or business abstraction", had abandoned the undertaking.

It is not within the scope of the present article to offer any general commentary or account, historical or critical, either of the nature of the expedition itself, or of the character of the work which was one of its results. The whole matter has passed into history, and the subject become "classic." I have already quoted the chapter of the work which alone bears formally and specially upon zoology, though incidental observations upon natural history are scattered throughout both volumes. In this connection, however, I should not omit to note a paragraph of the editor's preface by which it appears that a separate publication upon the natural-history observations and collections was then contemplated. Mr. Allen says: "The present volumes, it will be perceived, comprise only the narrative of the journey. Those parts of the work which relate to the various objects of natural history, observed or collected during the journey, as well as the alphabets of the Indian languages, are in the hands of Professor Barton, and will, it is understood, shortly appear." Having never seen or heard of any publication by Professor Barton on the subject, I am forced to the conclusion that this *projet* was never carried out. Thus it would appear that the net results of the expedition, as far as natural history is concerned, are contained in the single chapter above cited. This subject will be resumed after examination of the various subsequent editions of "Lewis and Clarke"* with which we have to do.

During the same year (1814), the work was published in London, under the editorship of Thomas Rees, in 1 vol. 4to, with the following title:—

[1814.] *Travels* | *to the* | *Source of the Missouri River* | *and across the* | *American Continent* | *to the* | *Pacific Ocean.* | *Performed* | *by order of the Government of the United States,* | *in the Years* 1804, 1805, *and* 1806. | — | *By Captains Lewis and Clarke.* | — | *Published from the Official Report,* | *and* | *illustrated by a map of the route,* | *and other maps.* | — | *London:* | *Printed for Longman, Hurst, Rees, Orme, and Brown,* | *Paternoster-Row.* | — | 1814.

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*The orthography of this name is uncertain. It is written "Clark" on the title-page of the present edition, but "Clarke" on that of nearly all the others examined. "Clarke" and "Clark" are both written by President Jefferson in his official communications, "Clarke" by Gass throughout his journal, and by Captain Lewis himself. Referring to the signatures of the private letters introduced in the "apocrypha," I find that the Philadelphia edition of 1809 prints the signatures "Clark," while in the Dayton edition of 1840 the signatures stand "Clarke." The balance of evidence is in favor of "Clarke."

One vol., 4to, pp. i–xxiv, 1–663, 1 folding and 2 full-page maps. (> *Chap. XXIV*, "*A general Description of the Beasts, Birds, and Plants, &c., found by the Party in this Expedition,*" *pp.* 450–489.)

"The present edition is printed nearly verbatim from the original; the sheets of which were forwarded to this country by the American proprietors: the only liberty that has been taken with the language, has been merely the correction of a few inadvertent grammatical or typographical errors. The American copy contained an Appendix drawn up by Captain Lewis on the State of the Indian Nations; . . . . but as the subject is altogether of a local nature, and the observations possess little interest for the British reader, it has been omitted." Besides the whole of the Appendix, which occupies 89 pages of the original, the Life of Lewis and the American editor's Preface are also omitted; in place of the latter being introduced a new preface by the English editor. This preface consists chiefly of a sketch of other explorations in the West, especially Lieutenant Pike's (which Rees had edited in 1811); it also includes President Jefferson's "Message," extract of a letter from Captain Lewis to the President, with bibliographical references to Jefferson's pamphlet of 1806, to the English edition (1809) of the apocrypha already quoted, and to Gass's Journal, which latter is spoken of in more complimentary terms than those used by the American editor. Excepting these points and those mentioned above in quotation-marks, this English 4to edition is identical with the original American one.

It was succeeded the next year by a 3-vol. 8vo reprint, as follows:—

[1815.] *Travels* | *to the source of* | *the Missouri River* | *and across the* | *American Continent* | *to* | *the Pacific Ocean.* | *Performed by order of* | *the Government of the United States,* | *in the years* 1804, 1805, *and* 1806. | — | *By Captains Lewis and Clarke.* | — | *Published from the Official Report,* | *and illustrated by a map of the route,* | *and other maps.* | — | *A new edition, in three volumes.* | *Vol. I.* [*II, III.*] | — | *London:* | *Printed for Longman, Hurst, Rees, Orme, and Brown,* | *Paternoster-Row.* | 1815.

Three vols., 8vo. Vol. I, pp. i–xxvi, 1 *l. not paged,* 1–411, *maps* 3. *Vol. II, pp. i–xii,* 1–434, *maps* 3. *Vol. III, pp. i–xii,* 1–394. (> *Vol. III, Chap. XXIV*, "*A general description of the beasts, birds, plants, &c., found by the party in this expedition,*" *pp.* 1–73.)

Except in form, and in some minor details of typography incident to resetting of the type, this is identical with the 4to edition of 1814.

This edition, convenient in form, and otherwise unexceptionable, is a favorite one, perhaps oftener met with, even in this country, than the original of 1814.

It was re-issued under date of 1817, apparently from the same plates; though I observe, on the last two pages of vol. I, a slight discrepancy in the set of the type. If re-issued subsequent to 1817, as may easily have been the case, the fact has not come to my notice. These two English 3 volume 8vo editions of 1815 and 1817 may be quoted without distinction, as the pagination is the same.

Meanwhile, in the year 1815, the work was translated into German and published in that language. The abridged title of a German version, not seen by me, is thus given by Kayser; I regret that I am unable to complete the title:—

[1815.] "(*Lewis und Clarke.*) *Tagebuch e. Entdeckungsreise durch Nord. Amerika in d. Jahren* 1804–6. *Aus d. Engl. v. Weyland. Mit* 1 *Karte.*" <*Neue Bibliothek der wichtigsten Beschreibungen, u. s. w.* (*Weimar, gr.* 8vo.) *Bd. I*, 1815.

To judge from the title and date of publication, this is probably a version of the authentic narrative. It is the only German edition of which I have become aware.

The next edition of the authentic narrative is a Dutch version, by Van Kampen, published in three 8vo volumes, at Dordrecht, 1816–18. It is entitled as follows:—

[1816–18.] *Reize* | *naar* | *de Bronnen van den Missouri,* | *en door het vaste land van America* | *naar de Zuidzee.* | *Gedaan op last van de Regering der Vereenigde Staten van America,* | *in de jaren* 1804, 1805 *en* 1806. | *Door de Kapiteins* | *Lewis en Clarke.* | *Met eene Kaart.* | — | *Uit het Engelsch vertaald door* | *N. G. Van Kampen.* | — | *Eerste* [*tweede, derde en Laatste*] *Deel.* | * | *Te Dordrecht,* | *Bij A. Blussé & Zoon.* | 1816. [1817, 1818].

Three vols. 8vo. Vol. I, 1816, *pp. i–xxxii,* 1–398, *map. Vol. II,* 1817, *pp. i–viii,* 1–390. *Vol. III,* 1818, *pp. i–xii,* 1–335.

This appears to be a fair and complete version, probably made from the English 3-volume edition of 1815 (Rees' preface being reproduced); the Dutch translator prefixes a preface of his own (Voorberigt van den Vertaler, pp. iii–xviii of vol. I.) Excepting this addition, the work seems to be exactly reproduced in Dutch.

While this Dutch translation was in progress, there appeared an Irish edition at Dublin, in 1817. I have been unable to lay hands on a copy of this edition, in connection with the publication of which I have heard the familiar allusion to "Dublin pirates." The most precise information I have gained respecting it is given by Thomas W. Field, from which it would appear that it is the authentic narrative. Mr. Field says: "Another edition of Biddle's [*i. e.*, "Paul Allen's"] history of Lewis and Clarke's expedition was printed in Dublin, under the same title as the London edition of three volumes, from which it was copied, with the addition on the title-page of,—' With the Life of Captain Lewis, by T. Jefferson, President of the United States of America.' In Two Volumes. Dublin, J. Christie, 1817. 8vo. Vol. I, prel. pp. xxxix.+588. Vol. II, prel. pp. xiv.+643+7 plates and map."

During the period from 1817 to 1842, there were no editions or reimprints of Lewis and Clarke that I know of. At the latter date, the Messrs. Harper and Brothers, having procured a copyright, made the first issue of a new and modified edition, prepared for them by the Rev. Dr. M'Vickar. There have been a great many (see beyond) successive re-issues of this handy little abridgment, all of which, however, appear to have been printed from the same plates. They are in fact the same edition, though in some of the copies I have seen the maps are omitted. The following title is quoted from the issue of 1868:—

[1842–75.] *History* | *of* | *the Expedition* | *under the command of* | *Captains Lewis and Clarke,* | *to* | *the sources of the Missouri, thence across the Rocky* | *Mountains, and down the River Columbia to the* | *Pacific ocean: performed during the* | *years* 1804, 1805, 1806, | *by order of the* | *Govern-*

ment of the United States. | *Prepared for the press* | *by Paul Allen, Esq.* | *Revised and abridged by the omission of unimportant de-* | *tails, with an introduction and notes,* | *by Archibald M'Vickar.* | *In two volumes.* | *Vol. I.* [*II.*] | *New York:* | *Harper & Brothers, Publishers,* | *Franklin Square.* | 1868.

Two vols. 18*mo, some of the issues forming part of Harpers' series, " The Family Library." Vol. I, pp. i–vi, i*–v*, vii–li,* 53–371, 3 *maps. Vol. II, pp. i–x,* 11–395, 3 *maps.* (> *Vol. II, Appendix, " Further enumeration and description of the Quadrupeds, Birds, Fishes, and Plants noticed during the Expedition," pp.* 339–378.)

By the obliging attentions of the publishers themselves, I have been put in possession of the following memoranda of the dates of the successive issues, most of which consisted of 250 copies: September, 1842; January, 1843; May, 1843; January, 1844; July, 1845; April, 1847; May, 1850; August, 1851; June, 1855; April, 1858; November, 1860; February, 1868; March, 1871 (vol. II); April, 1872 (vol. I); February, 1874 (vol. II); December, 1875 (vol. I.)—in all fourteen issues of the whole work, under sixteen different dates.

The advertisement of this edition, dated 1842, fully explains its character, in the following extract: " The work [*i. e.*, the Biddle-Allen edition] being now nearly out of print, it seemed to the publishers a suitable time to put forth an edition of the Journal of Lewis and Clarke pruned of unimportant details, with a sketch of the progress of maritime discovery on the Pacific coast, a summary account of earlier attempts to penetrate this vast wilderness, and such extracts and illustrations from the narratives of later travellers, led by objects of trade, the love of science, or religious zeal, as the limits of the undertaking would allow. [The editor's, M'Vickar's, introduction, pp. vii–li of vol. I, consists of this matter.] The matter of the original journal is indicated by inverted commas, and where portions of it, embracing minute and uninteresting particulars, have been omitted, the leading facts have been briefly stated by the editor in his own words, so that the connection of the narrative is preserved unbroken, and nothing of importance is lost to the reader. . . . The seventh chapter of the second volume [of American edition of 1814], giving an account of the quadrupeds, birds, and plants found on the Columbia and its tributaries, has, to avoid unnecessary interruption of the course of the narrative, been transferred to the appendix."

This, then, is an editorial abridgment, or digest, of the original; faithfully, and, on the whole, judiciously executed. The natural-history chapter, besides being relegated to an appendix, is transposed as to its botanical and zoological portions, the botany coming first in the original, the zoology in the present edition; it is, furthermore, like the rest of the work, abridged at the editor's discretion, the omissions being indicated by asterisks; a new feature, moreover, is introduced, being foot-note references to the pages of the body of the work on which the various species were before mentioned. This is a valuable set of cross-references, for the narrative accounts scattered through the work are often no less important than the formal notices themselves.

Résumé of the several publications noticed in the foregoing pages.

I. Jefferson's Message and accompanying documents, 8vo,* Washington, A. & G. Way, 1806.—The same, 8vo, New York, Hopkins and

Seymour, 1806.—The same, 8vo, London, R. Phillips, 1807.—The same, mutilated, abridged, and with irrelevant interpolation, 8vo, London, 1809.—The same, 12mo, Philadelphia, H. Lester, 1809.—The same, with slight modification, 12mo, Baltimore, W. Fisher, 1812 and 1813.—The same, with slight further alteration, 16mo, Dayton, B. F. Ells, 1840.—8 editions.

II. Gass' Journal, 12mo, Pittsburgh, D. M'Keehan, 1807.—The same, "8vo, Pittsburgh, 1808" (not seen by me.)—The same, "8vo, London, J. Budd, 1808" (not seen by me).—The same, 12mo, Philadelphia, M. Carey, 1810, and "1812" (latter not seen by me).—The same (?), "8vo, Paris, A. Bertrand, 1810" (French translation, not seen by me).—6 editions.

III. The Biddle-Allen authentic narrative, 2 vols., 8vo, Philadelphia, 1814.—The same, 4to, London, T. Rees, 1814.—The same, 3 vols., 8vo, London, T. Rees, 1815 and 1817.—The same (?), "8vo, Weimar, 1815" (German translation, not seen by me).—The same, 3 vols., 8vo, Dordrecht, A. Blussé & Zoon, 1816–18 (Dutch translation).—The same, 2 vols., 8vo, Dublin, J. Christie, 1817 (not seen by me).—The same, abridged, with notes, 2 vols., 18mo, New York, Harper & Bro., 1842–75.—21 editions.

In all, 35 different imprints of the three series of books, about 20 of which may be considered as *bona fide* different editions.

Having thus traced the history of the numerous "Lewis and Clarkes," authentic, abridged, spurious, or collateral, I proceed to a commentary on the zoological results of the expedition, as far as concerns the mammals and birds, to which the authors' attention was mainly directed.

PART II.—ZOOLOGICAL.

The contribution to zoology made by Lewis and Clarke, though not extensive, shares the interest which attaches to every result of this unprecedented expedition, and assumes, moreover, great importance, in the fact that to it we owe our first acquaintance with a large number of species. It represented a decided advance upon the knowledge before possessed of this subject. Lewis and Clarke were the real discoverers, and actually the original describers, of many animals with which their names are seldom associated now in our acquired familiarity with the same species under names subsequently bestowed by others. They were not trained naturalists,* nor naturalists at all, excepting in so far as good observers in any new field, keenly alive to the requirements of the case, become naturalists as a matter of course. Unfortunately for themselves, they imposed no scientific names, which throws them out of the case in questions of nomenclature. But their descriptions, characterized by a straightforward simplicity, and in general accurate, suffice for the identification of most of their species, and many of them are the whole basis of scientific terms afterward introduced into the system. These descriptions of physical characters are often accompanied by notices of habits, of geographical distribution, economic importance, &c. The authors seem to have paid more attention to the mammals and birds than to other classes of animals, and were certainly more successful in presenting them intelligibly. To these two classes, therefore, attention will be here confined.

It is my present purpose to notice in detail the several mammals and birds described by Lewis and Clarke, dwelling specially upon such as were discovered by them, or those upon which species were subse-

* Thus, "shell-fish" (*Mollusca*) and whales are enumerated as fishes, and bats as birds.

quently established, whether rightly or not, in the recognized system of nomenclature.

It should be observed that attention is not to be restricted to the set of formal general descriptions gathered in the special part of the work above signalized; for scattered throughout the narrative are other accounts sometimes quite as much to the point. Nearly all the animals mentioned are, however, brought together in the chapter specially devoted to this purpose, though there are some notable exceptions.

The writer who imposed most of the names which have been based primarily and exclusively upon Lewis and Clarke was, as will be seen, Mr. George Ord. This was done in the zoological portion of the second American edition of Guthrie's Geography,* second volume, a work which appeared in 1815, thus immediately after the first authentic edition of the narrative. The article in question remained obscure, being seldom if ever quoted, until brought into its proper light by Prof. S. F. Baird, in his studies of American Mammals and Birds (1857 and 1858). About the same time, or shortly afterward, some of Lewis and Clarke's species fell in the way of C. S. Rafinesque, who also based some names, generic and specific, upon their descriptions, and in so doing gave trouble, much as usual. The narrative, becoming at once widely known, has continued to be freely cited to the present day.

In the account with which I continue, four leading editions of the authentic narrative are quoted by pages, and are severally distinguished as follows:—

"*Allen*" signifies the original 2-vol. American edition, of 1814.
"*Rees*, 4to," signifies the first English edition, of the same date.
"*Rees*, 8vo," signifies the second English, 3-vol., 8vo edition, of 1815.
"*M'Vickar*" signifies the last American, 2-vol., 18mo edition, of 1842–'75.

1.—*Mammals.*

Lewis and Clarke divide the quadrupeds of the country from the Rocky Mountains to the Pacific into (1) the domestic and (2) the wild. Of the former only the horse and dog are mentioned. Of (2) are given "the brown, white, or grisly bear, the black bear; the deer, common red deer, the black-tailed deer, the mule deer, the elk, the wolves, the large brown wolf, the small wolf of the plains, the large wolf of the plains, the tyger-cat, the foxes, the common red fox, the silver fox, the fisher or black fox, the large red fox of the plains, the kit-fox, or the small fox of the plains, the antelope, the sheep, beaver, common otter, sea-otter, mink, seal, racoon, squirrels, large gray squirrel, small gray squirrel, small brown squirrel, ground squirrel, braro, rat, mouse, mole, panther, hare, rabbit, polecat or skunk." (Allen, ii. 165.)

"*Brown, White, or Grisly Bear.*"

Allen, ii. 165 (cf. op. cit. i. 200, 207, 214, 216, 265, 281; ii. 287, 303, 342, 395).—Rees, 4to, 462 (cf. op. cit. 147, 157, 158, 202, 208, 553, 565, 593, 632).—Rees, 8vo, iii. 25 (cf. op. cit. 273, 284, 292, 296, 362, 388;

* This book is rare: I have seen but one copy. The title is "A new | Geographical, Historical, | and | Commercial Grammar; | and present state of the | several Kingdoms of the World. | Containing, | [then follows summary of contents, &c., too long to quote]. Johnson and Warner. Philadelphia. 1815. 8vo. 2d vol. prel. pp., pp. 1–603, maps. Mr. Ord's zoological matter will be found at pp. 290–361. It consists of compiled nominal lists of vertebrates, followed by a general running account of some of them. Many new species are named, especially of mammals and birds.

iii. 193, 215, 294, 340, 341).—M'Vickar, ii. 340 (cf. op. cit. i. 189, 195, 198, 200, 227, 240; ii. 225, 235, 264, 299).

Ursus horribilis, Ord, Guthrie's Geog. ii. 1815, 291, 299.

Ursus ferox, Richardson, Fn. Bor.-Am. i. 1829, 24, pl. 1.

Ursus candescens, H. Smith, Griff. Cuv. ii. 1827, 229; v. 1827, 112; plate from Lewis and Clarke's specimen.

Lewis and Clarke's accounts furnish the basis of Ord's name. They are quoted by Richardson as authors of the name *Ursus ferox;* but as I fail to find any such name after diligent search in all the places of the several editions where the species is mentioned (*vide* the quotations above), it seems probable that "Ursus ferox" is merely a latin translation of the vernacular. The Grizzly Bear was found to be so numerous and so fierce, especially in the Upper Missouri region, as to form a serious impediment to progress, and an enemy that not seldom endangered the lives of members of the party. The authors carefully distinguish it from the following species, in all its great variety of color, which they are at pains to describe repeatedly, laying special stress upon size and form of the feet and claws, dimensions and general build, inability to climb tress, ferocity, and tenacity of life.

"*Black Bear.*"

Allen, ii. 166.—Rees, 4to, 463.—Rees, 8vo, iii. 25.—M'Vickar, ii. 340.

Ursus americanus, Pallas, Spic. Zool. xiv. 1780, and of authors.

Black Bear, Pennant, Hist. Quad. 1781, No. 174; Arct. Zool. i. 1784, 57.

Referred by the authors to the common species of the United States; sta to inhabit timbered portions of the Rocky Mountains, and borders of the Columbia Plains, as well as the tract thence to the Pacific.

"*Common Red Deer.*"

Allen, ii, 166.—Rees, 4to, 463.—Rees, 8vo, iii. 26.—M'Vickar, ii. 341.

Cervus macrourus, Rafinesque, Am. Month. Mag. i. 1817, 436.

Cervus leucurus, Dougl., Zool. Journ. iv. 1829, 330.

Giving the habitat of this deer to be from the Rocky Mountains to the Pacific, the authors state that it does not appear to differ essentially from that of the United States (*i. e.*, *C. virginianus*), "being the same in shape, size, and appearance. The tail is, however, different, which is of unusual length, far exceeding that of the common deer. Captain Lewis measured one, and found it to be 17 inches long." The two names above quoted have been based upon this deer of the West; Douglas's referring more particularly to the Pacific animal, while Rafinesque's (which has priority) rests upon an uncertain description by Leraye, of an animal from the Missouri region. The great length of the tail ascribed by Lewis and Clarke has been found not to hold in all cases, the tail being usually but 12 or 14 inches long, and thus little more than that of the ordinary *C. virginianus*. Naturalists are now reverting to the original opinion of Lewis and Clarke that the animal cannot be specifically separated from the last named. For those who wish to recognize varietal distinction, the name *macrourus* of Rafinesque is available, having priority over *leucurus* of Douglas. The deer is given as *C. virginianus macrurus* by Dr. Yarrow and myself in a volume now about issuing from the press (December, 1875).

"*Black-tailed Fallow Deer.*"

Allen, ii. 166.—Rees, 4to, 463.—Rees, 8vo, iii. 25.—M'Vickar, ii. 341.

Cervus macrotis var. *columbianus*, Rich., Fn. Bor.-Am. i. 1829, 255, l. 20.

Cervus lewisii, Peale, U. S. Expl. Exped. 1848, 39.
Cervus richardsonii, Aud. and Bach., Quad. N. Am. ii. 1851, 211; iii. 1853, 27, pl. 106.

The authors correctly distinguish the Black-tailed Deer of the Pacific slopes from the Mule Deer, and were perfectly right in considering it as a distinct species. It seems to have been first named technically in 1829 by Richardson; it was subsequently dedicated by Peale to Captain Lewis, and afterward rededicated by Audubon and Bachman to Sir John Richardson.

"*Mule-Deer.*"

Allen, ii. 167.—Rees, 4to, 463.—Rees, 8vo, iii. 27.—M'Vickar, ii. 341.
Cervus macrotis, Say, Long's Exped. R. Mts. ii. 1823, 88.

In most parts of the West, this well-known and wide-ranging species is known chiefly as the "Black-tailed Deer," to distinguish it from the "White-tailed" (*i. e.*, *C. virginianus macrurus*). The Columbian, or true Black-tailed Deer of Lewis and Clarke, having the same vernacular name, unnecessary confusion has always prevailed to some extent, especially among sportsmen and amateur naturalists. There are, however, three perfectly good species of deer in the West, precisely as originally discriminated by Lewis and Clarke, and as here given.

"*The Elk.*"

Allen, ii. 167.—Rees, 4to, 464.—Rees, 8vo, iii. 27.—M'Vickar, ii. 341.
Cervus wapiti, Barton, Trans. Am. Philos. Soc. vi. 1809, 70.
Cervus major, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 292, 306.
Cervus or *Elaphus canadensis* of authors.

"*Large Brown Wolf.*"—"*Large Wolf of the Plains.*"

Allen, ii. 167.—Rees, 4to, 464.—Rees, 8vo, iii. 27, 28.—M'Vickar, ii. 341, 342.

Lewis and Clarke are less fortunate in treating of the wolves, since they separate the single large species which exists into two, on the unsafe ground of color, and unite one of their varieties with the entirely different Coyoté (*C. latrans*). The mistake, however, might readily be made, since the Large Gray Wolf of the Plains, in its usual style of coloration, is almost identical with the Coyoté. No species, fortunately, appears to have been based directly upon Lewis and Clarke's account.

"*Small Wolf of the Plains.*"

Allen, ii. 167.—Rees, 4to, 464.—Rees, 8vo, iii. 28.—M'Vickar, ii. 342.
Canis latrans, Say, Long's Exped. R. Mts. i. 1823, 168, and of authors generally.

From what has been said, it will appear that Lewis and Clarke insufficiently distinguished this animal from the last, though they were perfectly familiar with it. It is carefully and fully described under the name of the "Small Wolf or Burrowing-Dog of the Prairies" in the body of the narrative (Allen, i. 207; Rees, 4to, 152; Rees, 8vo, i. 283; M'Vickar, i. 194). No species has been based upon their account.

"*Tiger-Cat.*"

Allen, ii. 167.—Rees, 4to, 464.—Rees, 8vo, iii. 28.—M'Vickar, ii. 342.
Lynx fasciatus, Rafinesque, Am. Month. Mag. ii. 1817, 46.

Under the singularly misleading name of "Tiger-Cat," the Lynx of the Northwest is elaborately described by the authors with minute accuracy. Rafinesque gave it the name of *Lynx fasciatus*, through a misunderstanding of the meaning of Lewis and Clarke, he supposing that they said the "back" was transversely striped, whereas it is evident from the context that they meant the back or inner side of the legs. The mistake is exposed by Baird (M. N. A. 1857, 98). The animal is now generally considered as a local race of the common *Lynx rufus*, though for many years rated as a distinct species.

"*Large Red Fox of the Plains.*"

Allen, ii. 168.—Rees, 4to, 464.—Rees, 8vo., iii. 29.—M'Vickar, ii. 342.

I refrain from any further citation in this case, since it is uncertain whether the actual reference is to the common species, or to the larger and otherwise somewhat different animal called *Vulpes macrourus* by Baird, and *V. utah* by Audubon and Bachman.

"*Black Fox.*"

Allen, ii. 168.—Rees, 4to, 465.—Rees, 8vo, iii. 29.—M'Vickar, ii. 342.
Mustela canadensis, Schreber, Säug. iii. 1778, 492, pl. 144; and authors.
Mustela pennantii, Erxleben, Syst. An. 1777, 479; and authors.

Better known under the name of "Fisher," also applied to it by the authors, who describe it sufficiently, and note its agility in climbing. Their use of the term "Black Fox" is to be carefully discriminated from any application of the term to the following variety of *Vulpes fulvus*.

"*Silver Fox.*"

Allen, ii. 169.—Rees, 4to, 465.—Rees, 8vo, iii. 29.—M'Vickar, ii. 343.
Canis argentatus, Shaw, Gen. Zool. i. 1800, 325.
Vulpes fulvus var. *argentatus* of modern authors.

A well-known strain of the common species, though it should be noted that the actual reference may have been to the same state of pelage of *V. macrurus*. The authors note its rarity and beauty, and compare it with their "Large Red Fox."

"*The Antelope.*"

Allen, ii. 169.—Rees, 4to, 465.—Rees, 8vo, iii. 430.—M'Vickar, ii. 343.
Antilope americana, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 292, 308.—Doughty's Cab. N. H. ii. 1833, 49, pl. 5 (from Lewis and Clarke's specimen in Phila. Mus).
Antilocapra americana, Ord, Bull. Soc. Philom. 1818, 146, and of most authors.

It is certainly not a little singular that a large ruminant, which in the West yields only to the Buffalo itself in its abundance and the universality of its distribution, should not have been scientifically named until 1815; yet, for all I can discover to the contrary, such is the case. Lewis and Clarke were of course not its discoverers, nor are their accounts the earliest, since, for example, the animal was mentioned by Hernandez; yet the imposition of Ord's name along with several others based exclusively upon these authors makes them virtually the sponsors of the species upon its introduction to the system.

"*The Sheep.*"

Allen, ii. 169.—Rees, 4to, 465.—Rees, 8vo, iii. 30.—M'Vickar, ii. 343.
Ovis montana, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 292, 309. (Not of authors generally.)
Capra montana, Harlan, Fn. Amer. 1825, 253.
Aploceros montanus of modern authors.

Lewis and Clarke were perfectly well acquainted with the Bighorn or true Rocky Mountain Sheep, as is evident in several places in their Narrative. It is somewhat singular that it should not be included in the formal enumeration, since it inhabits the Rocky Mountains as well as the Upper Missouri region. But the "sheep" here referred to is the animal now known as the Rocky Mountain Goat, as evidenced by their mention of long, white wool and erect, pointed horns. Here, somewhat as in the case of the Antelope, the authors are sponsors of the species, having given one of the earliest, if not the first, perfectly recognizable account.

"*The Beaver.*"

Allen, ii. 170.—Rees, 4to, 466.—Rees, 8vo, iii. 31.—M'Vickar, ii. 344.
Castor fiber of early American authors.
Castor canadensis, Kuhl, Beit. Zool. 1820, 64, and most late American writers.

The account is chiefly occupied with the castor of the animal, mode of using it, &c.

"*Common Otter.*"

Allen, ii. 171.—Rees, 4to, 467.—Rees, 8vo, iii. 32.—M'Vickar, ii. 344.
Lutra canadensis, J. Sab., App. Frankl. Journ. 1823, 653.
Lutra canadensis et californica, Bd., M. N. A. 1857, 184, 187.

Simply mentioned as the same as that of the United States.

"*Sea Otter.*"

Lutra marina, Steller, Nov. Comm. Petrop. ii. 1751, 357, pl. 16.
Enhydra marina, Fleming, Phil. Zool. ii. 1822, 187.

The authors give a fair description of this animal, then known, however, for more than half a century, from the account given by Steller.

"*The Mink.*"

Allen, ii. 172.—Rees, 4to, 467.—Rees, 8vo, iii. 33.—M'Vickar, ii. 345.
Mustela vison, Briss., Quad. 1756, 246.
Putorius vison, Gapper, Zool. Journ. v. 1830, 202, and of late authors generally.

"*The Seal.*"

The description given by the authors does not afford means of identifying the species to which they refer.

"*The Raccoon.*"

Allen, ii. 172.—Rees, 4to, 467.—Rees, 8vo, iii. 34.—M'Vickar, ii. 345.
? *Procyon hernandezii*, Wagler, Oken's Isis, xxiv. 1831, 514.

No description is given, and we can only suppose, from the locality, that the actual reference is to this species or variety.

"Large Gray Squirrel."

Allen, ii. 172.—Rees, 4to, 468.—Rees, 8vo, iii. 34.—M'Vickar, ii. 345.
Sciurus fossor, Peale, U. S. Expl. Exped. 1848, 55.
Sciurus heermanni, LeConte, Proc. Acad. Phila. 1852, 149.

As has been remarked by Professor Baird, it is not a little singular that an animal described with such detail by these authors was not named by early writers like Ord, Rafinesque, and Harlan, though other species were so promptly introduced into the system; but I have seen no name for the species earlier than that bestowed by Peale.

"Small Gray Squirrel."

Allen, ii. 173.—Rees, 4to, 468.—Rees, 8vo, iii. 35.—M'Vickar, ii. 345.
? *Sciurus hudsonius* var. β, Rich., Fn. Bor.-Am. i. 1829, 190.
? *Sciurus richardsoni*, Bachm., P. Z. S. 1838, 100.

This animal is said to be common in all timbered portions of the Rocky Mountains. From the description, especially the mention of the black stripe along the sides, it is clearly one of the *S. hudsonius* group, but it is difficult to fix it precisely. As, however, the *S. douglassii* is the one evidently referred to under the name (see below) of "Small Brown Squirrel," we may suppose, upon the principle of exclusion, that by "Small Gray Squirrel" the authors meant the one subsequently named *S. richardsoni* by Dr. Bachman.

"Burrowing Squirrel."

Allen, ii. 173.—Rees, 4to, 468.—Rees, 8vo, iii. 35.—M'Vickar, ii. 346.
Arctomys columbianus, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 292, 303 (based on Lewis and Clarke).
Cynomys columbianus, Allen, Proc. Bost. Soc. Nat. Hist. 1874, p. —.
Anisonyx brachiura, Rafinesque, Am. Monthly Mag. ii. 1817, 45.
Arctomys brachyura, Harlan, Fn. Amer. 1825, 304.
Arctomys lewisii, Aud. & Bach., Quad. N. A. iii. 1853, 32, pl. 107 (based on a specimen in Zool. Soc. Lond. labeled "*Arctomys brachyura*").
Cynomys gunnisonii, Baird, Proc. Acad. Phila. 1855, 334.

Notwithstanding that the authors' description of this animal is one of the most elaborate and extended of the whole series, it has occasioned misunderstanding, and given rise to numerous synonyms. The first author to take up the account seems to have been Ord, who bases his *Arctomys columbianus* upon the animal, and quotes Lewis and Clarke at length. In 1817, Rafinesque, upon a misconstruction of a phrase used by the authors, based his genus *Anisonyx* with the species *A. brachiura*. In treating of *C. gunnisoni*, which he had named in 1855, Professor Baird, in 1857, discussed the applicability of all these names to the Burrowing Squirrel of Lewis and Clarke, bringing the *Arctomys lewisii* of Audubon and Bachman into the same connection. Very recently, in his admirable review of the Sciuridæ, Mr. J. A. Allen has first collated the full synonymy, identifying the several supposed species here mentioned with the animal of Lewis and Clarke.

"Small Brown Squirrel."

Allen, ii. 174.—Rees, 4to, 469.—Rees, 8vo, iii. 37.—M'Vickar, ii. 347.
Sciurus douglassii, Bachm., P. Z. S. 1838, 99.
Sciurus townsendii, Bachm. Journ. Acad. Phila. viii. 1839, 63.
Sciurus belcheri, Gray, Ann. Mag. N. H. X. 1842, 263.
Sciurus suckleyi, Baird, Proc. Acad. Phila. 1855, 333.

The description given, like that of the "Small Gray Squirrel," clearly indicates a form of the *S. hudsonius* group, while the statement that the belly is "pale-red" would seem to fix the species as the same as that afterward successively described under the four different names above quoted.

"*Ground Squirrel.*"

Allen, ii. 175.—Rees, 4to, 469.—Rees, 8vo, iii. 38.—M'Vickar, ii. 347.
? *Tamias townsendii*, Bachm., Journ. Phila. Acad. viii. 1839, 68.
? *Tamias hindsii*, Gray, Ann. Mag. N. H. x. 1842, 264.
? *Tamias cooperi*, Baird, Proc. Acad. Phila. 1855, 334.

The authors do not distinguish this animal from the common species of the United States, and give no description; it is only therefore to be presumed, from the locality, that they had this species of *Tamias* in view.

"*Barking Squirrel.*"

Allen, ii. 175.—Rees, 4to, 469.—Rees, 8vo, iii. 38.—M'Vickar, ii. 348.
Arctomys ludoviciana, Ord, Guthrie's Geog. 2d. Am. ed. ii. 1815, 292, 302 (based on Lewis and Clarke).
Cynomys socialis, *C. grisea*, Rafinesque, Am. Monthly, ii. 1817, 45.
Arctomys missouriensis, Warden's Descr. U. S. v. 1820, 627.
Arctomys latrans, Harl., Fn. Amer. 1825, 306.
Cynomys ludovicianus of recent authors.

A full and excellent account of this species is given by the authors, who seem to have been the first to describe this species of *Cynomys*, as well as the foregoing one; and upon their account, quoted at length, Ord based his name.

"*Sewellel.*"

Allen, ii. 176.—Rees, 4to, 470.—Rees, 8vo, iii. 39.—M'Vickar, ii. 348.
Anisonyx rufa, Rafinesque, Am. Monthly Mag. ii. 1817, 45.
Aplodontia leporina, Richardson, Zool. Journ. iv. 1829, 335; Fn. Bor.-Am. i. 1829, 211, pl. 18, C., f. 7–14, and of recent authors.

This curious animal, fully and pertinently described by Lewis and Clarke, was soon after named *Anisonyx rufa* by Rafinesque, whose name may require to stand, as it is based entirely upon Lewis and Clarke, though the generic term *Anisonyx* arose in a misunderstanding of his, and rather bears upon *Cynomys* than upon *Aplodontia*.

"*Braro.*"

Allen, ii. 177.—Rees, 4to, 471.—Rees, 8vo, iii. 40.—*Blaireau*, M'Vickar, ii, 349.
American Badger, Pennant, Arct. Zool. i. 1784, 71.
Meles taxus, var. *americanus*, Bodd., Elench. Anim. i. 1784, 136.
Ursus labradorius, Gm., Syst. Nat. i. 1788, 102.
Meles jeffersonii, Harl., Fn. Amer. 1825, 309 (based on Lewis and Clarke).

Under the term "Braro," evidently a corruption of the French "blaireau," and so corrected in the M'Vickar edition, the authors very fully describe the Badger, already well known, however, by previous accounts, though in 1825 a special name was based by Harlan upon their description.

"*The Rat.*"

Allen, ii. 178.—Rees, 4to, 471.—Rees, 8vo, iii. 41.—M'Vickar, ii. 350. (See also Allen, i. 289; Rees, 4to, 212—Rees, 8vo, ii. 396; M'Vickar, i. 244.)

Mus cinereus, Ord, Guthrie's Geogr. 2d Am. ed. ii. 1815, 292 (based on Lewis and Clarke).
Neotoma cinerea, Baird, M. N. A. 1857, 499.
Myoxus drummondii, Rich., Zool. Journ. iii. 1828, 517.
Neotoma drummondii, Rich., Fn. Bor.-Am. i. 1829, 137, pl. 8.
Neotoma occidentalis, Coop., MSS.—Bd., Proc. Acad. Phila. 1855, 335; M. N. A. 1857, 496.

The bushy-tailed *Neotoma* of the West is very clearly noted by the authors, who even institute comparisons between it and *N. floridana* of the South Atlantic States, with which Captain Lewis seems to have been also familiar. The description given at the earlier page above quoted is better than that in the formal enumeration. This animal is the basis of *Mus cinereus* of Ord.

"*The Mouse.*"

Allen, ii. 178.—Rees, 4to, 472.—Rees, 8vo, iii. 42.—M'Vickar, ii. 350
No description; not identifiable.

"*The Mole.*"

Allen, ii. 178.—Rees, 4to, 472.—Rees, 8vo, iii. 42.—M'Vickar, ii. 350.

Not described, nor distinguished from the common mole of the United States, though the actual reference is doubtless to the animal subsequently named *Scalops townsendii* by Bachman.

"*The Panther.*"

Allen, ii. 178.—Rees, 4to, 472.—Rees, 8vo, iii. 42.—M'Vickar, ii. 350.
Felis concolor, Linn., Mantissa, 1771, 522, pl. 2.

"*The Hare.*"

Allen, ii. 178.—Rees, 4to, 472.—Rees, 8vo, iii. 42.—M'Vickar, ii. 42.
Lepus virginianus, var., Harl., Fn. Amer. 1825, 310.
Lepus virginianus, Rich., Fn. Bor.-Am. i. 1829, 224; not of authors.
Lepus campestris, Bach., Journ. Phila. Acad. vii. 1837, 340.
Lepus townsendii, Bach., Journ. Phila. Acad. viii. 1839, 90, pl. 2.

The Hare described at length by Lewis and Clarke is one of the very large species called "Jackass Rabbits" in the West; it is also one of those which turn white in winter; and their explicit mention of the *white* tail seems to fix their species as that which has acquired the synonymy above quoted. In crossing the country, they must have become perfectly familiar with the now *L. campestris*, which is the characteristic species of Dakota and Montana; and, as they make no discrimination of a Pacific-side species different from that of the Missouri plains, it is fair to identify their account as is here done, although they may have actually included in it another species.

"*The Rabbit.*"

Allen, ii. 179.—Rees, 4to, 473.—Rees, 8vo, iii. 44.—M'Vickar, ii. 351.
Lepus nuttallii, Bach., Journ. Phila. Acad. vii. 1837, 345, pl. 22.
Lepus artemisia, Bach., Journ. Phila. Acad. viii. 1839, 94.

The authors' account is brief and not descriptive; but the indication, coupled with the locality, leaves no doubt of the species they had in view.

" *The Polecat.*"

Allen, ii. 179.—Rees, 4to, 473.—Rees, 8vo. iii. 44.—M'Vickar, ii. 351.
Viverra mephitica, Shaw, Gen. Zool. i. 1800, 390.
Mephites chinga and *M. americana* of authors.

A short account of this animal, which, as the authors say, is the same as that of other parts of North America.

2.—*Birds.*

" *The Grouse or Prairie-hen.*"

Allen, ii. 180.—Rees, 4to, 473.—Rees, 8vo. iii. 44.—M'Vicar, ii. 351.
Phasianus columbianus, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 317 (based on Lewis and Clarke).
Pediocætes columbianus, Elliot, Proc. Acad. Phila. 1862, 403.
Pediœcetes phasianellus, var. *columbianus*, Coues, Birds Northwest, 1874, 407.
? *Tetrao phasianellus*, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 317 (uncertain).

The authors' account is extended and sufficiently minute to show that they had in view the " Sharp-tailed Grouse," or *Pediœcetes phasianellus* of writers who refer to the United States bird. In giving the name " Columbia Pheasant" to this bird (coupled with the technical term "*Phasianus columbianus*"), Ord must not be understood as quoting Lewis and Clarke; for no such name is found in their work: they give the bird under the caption above cited, and the "Pheasants" they speak of are species of *Tetrao* and *Bonasa*. The quotation of " the Columbia Pheasant of Lewis and Clarke" has been copied by several writers, myself among the number, evidently without looking up the original. As describers of the United States *Pediœcetes*, Lewis and Clarke have probably priority; though the Arctic form, the true *Tetrao phasianellus* of Linnæus, had long before been recorded by other writers.

" *Cock of the Plains.*"

Allen, ii. 180.—Rees, 4to, 473.—Rees, 8vo. iii. 45.—M'Vickar, ii. 352.
Tetrao urophasianus, Bp., Zool. Journ. iii. 1828, 214.
Centrocercus urophasianus of modern writers.

It is singular that Ord, in naming so many species of Lewis and Clarke's, should be entirely silent respecting this one, which they describe at length and with particularity, perhaps for the first time. The earliest name I have found for it is that of Bonaparte just given.

" *Large Black and White Pheasant.*"

Allen, ii. 181.—Rees, 4to, 474.—Rees, 8vo, iii. 47.—M'Vickar, ii. 353

" *Small Speckled Pheasant.*"

Allen, ii. 182.—Rees, 4to, 475.—Rees, 8vo, iii. 48.—M'Vickar, ii. 354.

" *Small Brown Pheasant.*"

Allen, ii. 182.—Rees, 4to, 475.—Rees, 8vo, iii. 48.—M'Vickar, ii. 354.

Tetrao fusca, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 317.

Notwithstanding that the authors give extended accounts of their three kinds of Pheasants, the descriptions are not of a character to render them readily available for identification of the species. The first, the "large black and white" one, would be taken for *Tetrao obscurus*, or its variety *richardsonii;* but the mention of eighteen feathers in the tail, and of "tufts of long black feathers" on the neck, militates against this supposition, rather suggesting *Bonasa*. Nevertheless, the two following species are said to be only "half the size" of this first one, which could only be true if the latter were as large as *T. obscurus*. The descriptions of all three, in fact, seem to have been drawn up from memory, with some confusion of ideas; and, however they may finally be identified, I think such identification likely to remain merely opinionative. The "Small Brown Pheasant" is the only one of the three upon which a specific name has been established, it being the basis of *Tetrao fusca* of Ord. This name has been referred by some late writers with a query to *Tetrao canadensis* var. *franklini*, but I do not see anything in the original account which forbids us to suppose it intended for *Bonasa umbellus* var. *sabinii*. The name of Ord should not be employed as long as the uncertainty continues.

"*The Buzzard.*"

Allen, ii. 183.—Rees, 4to, 475.—Rees, 8vo, 48. M'Vickar, ii. 354.
Vultur californianus, Shaw, Nat. Misc. ix. 1797, pl. 301.
Cathartes californianus of recent authors in general.
Vultur columbianus, Ord, Guthrie's Geog. 2d Am. ed. ii. 1815, 315, (based on Lewis and Clarke).
Cathartes vulturinus, Temm., Pl. Color. 1820, 31.

Under the name of "Buzzard" the authors minutely describe the great Californian Vulture, which, though already provided with a name, was renamed by Ord, upon the strength of their description, and subsequently by Temminck, apparently upon some principle like *stet pro ratione voluntas*, for the last-named author was sufficiently aware that there was a prior designation.

"*The Robin.*"

Allen, ii. 184.—Rees, 4to, 476.—Rees, 8vo, iii. 50.—M'Vicar, ii. 355.
Turdus nævius, Gm., Syst. Nat. i. 1788, 817, and of authors.
Turdus auroreus! Pall., Zoog. Rosso-As. i. 1831, 448, No. 87.
Orpheus meruloides, Sw. & Rich., Fn. Bor.-Am. ii. 1831, 187, pl. 38.

Described with great particularity and with accuracy. Here given under the common name, which is more frequently used in connection with *Turdus migratorius;* the authors distinguish it from the latter, a little further on, as the "Columbian Robin."

"*Crow and Raven.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, iii. 51.—M'Vicar, ii. 356.

No description is given, and in fact the authors speak of the two birds as if they were one. An allusion to the small size of the Columbia River bird permits the supposition that they may have had *Corvus caurinus* in partial view.

"*The Hawks.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, 51. M'Vickar, ii. 356.

The authors give no recognizable account of the several Hawks they treat of collectively in a single paragraph; though the allusion to the "blue wings" of one of them may be supposed to signify *Circus.*

"*Large Blackbird.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, iii. 51.—M'Vickar, ii. 356.

Nothing on which to base even a surmise.

"*Large Hooting Owl.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo. iii. 51.—M'Vickar, ii. 356.

May be supposed to refer to *Bubo virginianus*, though there is nothing requiring such identification.

"*Turtle Dove and the Robin.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, iii. 52.—M'Vickar, ii. 356. *Zenaidura carolinensis* and *Turdus migratorius.*

"*The Magpie.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, iii. 52.—M'Vicar, ii. 356. *Pica hudsonica* of authors.

"*Large Woodpecker or Laycock.*"

Allen, ii. 185.—Rees, 4to, 477.—Rees, 8vo, iii. 52.—M'Vickar, ii. 356.

"Laycock," though repeated in all the editions, is an evident misprint for "Logcock," a common name of *Hylatomus pileatus.*
The "Lark Woodpecker" mentioned without description in the same paragraph is not identifiable, but we may suppose it to be a *Colaptes*, from the resemblance of the black pectoral crescent to that of a *Sturnella*, called Lark by the authors.

"*The Lark.*"

Allen, ii. 186.—Rees, 4to, 477.—Rees, 8vo, iii. 52.—M'Vickar, ii. 356. *Sturnella neglecta*, Aud., B. Amer. 8vo ed. vii. 1843, 339, pl. 487.

"*Flycatcher, of two species.*"

Allen, ii. 186.—Rees, 4to, 477.—Rees, 8vo, iii. 52.—M'Vickar, ii. 356.

Under this head, the authors describe two small birds, but not recognizably; I do not even pretend to say to what family they belong.

"*Blue-crested Corvus.*"

Allen, ii. 186.—Rees, 4to, 478.—Rees, 8vo, iii. 53.—M'Vickar, ii. 357. *Cyanura stelleri* of authors.

"*Small White-breasted Corvus.*"

Allen, ii. 186.—Rees, 4to, 478.—Rees, 8vo, iii. 53.—M'Vickar, ii. 357.

In the earlier editions the name is as given here; M'Vickar, upon what authority does not appear, has it "*White-crested.*" I do not know what bird is intended by this, unless the authors refer to *Cyanocitta.*

"*The Snipe, &c.*"

Allen, ii. 186.—Rees, 8vo, 478.—Rees, 8vo, iii. 53.—M'Vickar, ii. 357.

Two species are indicated, one of them probably *Gallinago wilsoni*, but neither of them certain.

(No. 17, the next "bird" mentioned by the authors, is the "Leather-winged *Bat*," an unidentifiable species of mammal.)

"*White Woodpecker.*"

Allen, ii. 186.—Rees, 4to, 478.—Rees, 8vo, iii. 53.—M'Vickar, ii. 356.

Mention of the "red head" of this species would seem to indicate *Melanerpes erythrocephalus*, but as this species scarcely inhabits the country, if at all, the actual reference is more probably to *Picus harrisi.*

"*Black Woodpecker.*"

Allen, ii. 187.—Rees, 4to, 478.—Rees, 8vo, iii. 54.—M'Vickar, ii. 357.
Picus torquatus, Wils., Am. Orn. iii. 1811, 31, pl. 20, f. 3.
Melanerpes torquatus, Bp., Consp. Av. i. 1850, 115.
Celeus torquatus, Woodh., Sitgreave's Rep. 1853, 90.
Asyndesmus torquatus, Coues, Proc. Acad. Phila. 1866, 56.
"*Picus lewisii*, Drapiez."

Described at length and with great particularity. Before the publication of this work, the bird had already been described by A. Wilson from the specimens brought in by Captain Lewis, to whom the species was dedicated, though only by the vernacular name of "Lewis's Woodpecker." According to G. R. Gray, the term "*Picus lewisii*" was, however, subsequently introduced by Drapiez. I have not been able to lay hand on the reference.

In this connection, special attention is directed to a name, *Picus montanus*, established by Ord in 1815, (Guthrie's Geog. 2d Am. ed. ii, 1815, p. 316), and which has usually been quoted as a synonym of this species. Reference to the original, however, will show that it does not belong here at all. Ord quotes Lewis and Clarke (Allen edition, i. 398) as the basis of his species *P. montanus*. Turning to this place, we read, "Among the woods, Captain Clarke observed a species of woodpecker, the beak and tail of which were white, the wings black, and every other part of the body of a dark brown; its size was that of the Robin, and it fed on the seeds of the pine." Now this is an entirely different bird from any mentioned in the formal summary we are here considering. There is much reason to believe, though some terms of the description do not fit exactly, that the bird here meant is the *Picicorvus columbianus*, which has a white tail, black wings, the rest of the body ashy (not unlikely to be called "brown" from recollection), which feeds upon pine-seeds, and the general habits and appearance of which strongly recall a Woodpecker; in fact, the bird has been mistaken for a Woodpecker by some scientific observers at least as late as 1872. At any rate, *Picus montanus* of Ord has nothing to do with *P. torquatus*. Is it possible that a species of *Picus*, with a white tail, remains to be discovered in the forests of the West? For we are instantly reminded, in this connection, of such a bird, described by the Prince Paul of Württemberg, under the name of *Picus leucurus*. But I am of opinion that this name also refers to the *Picicorvus columbianus*.

"*Calamut* (*or Calumet*) *Eagle.*"

Allen, ii. 188.—Rees, 4to, 479.—Rees, 8vo, iii. 55.—M'Vickar, ii. 357.

Aquila chrysætos, *melanætos*, *fulva*, *canadensis*, *regia*, &c., of authors.

The Golden Eagle of North America is described in detail by the authors under the above name. Their account is copied, or compiled, with comment, by numerous writers.

"*Large Blue and Brown Herons, or Cranes.*"

Allen, ii. 189.—Rees, 4to, 479.—Rees, 8vo, iii. 56.—M'Vickar, ii. 358.
Ardea canadensis, Linn., S. N. i. 1766, 234.
Grus canadensis of authors.

"*Fishing Hawk.*"

Allen, ii. 189.—Rees, 4to, 480.—Rees, 8vo, iii. 57.—M'Vickar, ii. 358.
Falco or *Pandion carolinensis* of authors.

"*Blue-crested or King-fisher.*"

Allen, ii. 189.—Rees, 4to, 480.—Rees, 8vo, iii, 57.—M'Vickar, ii. 358.
Ceryle alcyon of authors.

"*Gulls.*"

Allen, ii. 189.—Rees, 4to, 480.—Rees, 8vo, iii. 57.—M'Vickar, ii. 359.

Four kinds are alluded to; none of them described.

"*The Cormorant.*"

Allen, ii. 189.—Rees, 4to, 480.—Rees, 8vo, iii. 57.—M'Vickar, ii. 359.
Graculus dilophus of authors.

This identification is permissible, from the authors' remark that the Cormorant is not different from that found on the Potomac River.

"*The Loon.*"

Allen, ii. 189.—Rees, 4to, 480.—Rees, 8vo, iii. 57.—M'Vickar, ii. 359.

Two species of "Loon," one of them apparently a Grebe, are noted, but neither of them is recognizably described.

"*White Brant.*"

Allen, ii. 190.—Rees, 4to, 481.—Rees, 8vo, iii. 58.—M'Vickar, ii. 359.
Anser hyperboreus, Pallas, Spic. Zool. viii. 1767, pl. 65, and of authors generally.

Very fully described in this place, and also earlier in the narrative (Allen, i. 206, &c.).

"*Brown Brant.*"

Allen, ii. 191.—Rees, 4to, 481.—Rees, 8vo, iii. 59.—M'Vickar, ii. 359.
Anas, *Anser*, or *Bernicla brenta* of authors.

Fully described, and compared with *B. canadensis*.

"*Pied Brant.*"

Allen, ii. 191.—Rees, 4to, 481.—Rees, 8vo, iii. 60.—M'Vickar, ii. 360.
Anser albifrons of American writers.
Anser gambeli, Hartl., R. M. Z. 1852, 7.

Like the other Brant, this species is described at length and with accuracy.

"*Geese.*"

Allen, ii. 192.—Rees, 4to, 482.—Rees, 8vo, iii. 61.—M'Vickar, ii. 360.

These are said to be "either the large or small kind"; by the former being evidently meant the *Bernicla canadensis*, while the other refers, it is to be supposed, to *B. hutchensii*. Neither is well described.

"*Swan, large and small.*"

Allen, ii. 192.—Rees, 4to, 482.—Rees, 8vo, iii. 61.—M'Vickar, ii. 360.

By their size and the difference in the voice, the two American species are correctly discriminated by Lewis and Clarke; unfortunately, however, they blunder in the matter by saying that the large species (*i. e.*, the one subsequently called *Cygnus buccinator* by Sir John Richardson) is the same as that common on the Atlantic coast; whereas, it is their other species, here called by them the Whistling Swan, in contradistinction to the Trumpeter, that is found also in the Atlantic States. But this confusion must not be allowed to stand in the light of the main point of this case, which is, that, in 1815, Ord based his *Anas columbianus* exclusively upon the Whistling Swan of Lewis and Clarke, *i. e.*, upon the smaller of the two species, subsequently named *Cygnus americanus* by Sharpless. The blunder of the original authors does not extend to Ord, to whose name *columbianus* should be restored its rightful priority.

"*Duckinmallard.*"

Allen, ii. 193.—Rees, 4to, 483.—Rees, 8vo, iii, 62.—M'Vickar, ii. 360.
Anas boschas of authors.

"*Canvas-back Duck.*"

Allen, ii. 193.—Rees, 4to, 483.—Rees, 8vo, iii. 62.—M'Vickar, 360.
Anas vallisneria of authors.

Red-headed Fishing Duck."

Allen, ii. 193.—Rees, 4to, 483.—Rees, 8vo, iii. 62.—M'Vickar, ii. 361.
? Filigula americana of authors.

"*Black and White Duck.*"

Allen, ii. 193.—Rees, 4to, 483.—Rees, 8vo, iii. 63.—M'Vickar, ii. 361.
Bucephala albeola of late authors.

"*Black Duck.*"

Allen, ii. 194.—Rees, 4to, 483.—Rees, 8vo, iii, 63.—M'Vickar, ii. 361.
Fulica americana, Gm., auct.

Very fully and accurately described.

"*Divers.*"

Allen, ii. 194.—Rees, 4to, 484.—Rees, 8vo, iii. 64.—M'Vickar, ii. 361.

Under this head the authors describe two species of *Podiceps*, the larger one being perhaps *P. occidentalis*, Lawr., but the description of neither is sufficiently diagnostic.

"*Blue-winged Teal.*"

Allen, ii. 195.—Rees, 4to, 484.—Rees, 8vo, iii. 65.—M'Vickar, ii. 361.

The paragraph beginning with this name goes on to describe a duck, apparently supposed, and intended to be considered, not as a Blue-winged Teal, but as some other species, for which no name is offered. The description, though lengthy, applies exactly to no species with which I am acquainted; but, from its general drift, I should suppose the authors had in view some species of *Fulix*, probably *F. marila*.

NOTICE OF A VERY LARGE GONIATITE FROM EASTERN KANSAS.

By F. B. Meek.

My attention was recently called by Mr. Stevenson, of Dr. Hayden's United States Geological Survey of the Territories, to a ponderous, irregular mass of hard limestone, that had been shipped to General Charles Ewing, from Osage, Eastern Kansas, by the Rev. Paul Ponziglione, of the Osage mission. It contained shells of *Spirifer cameratus*, *Athyris subtilita*, and other forms common in the upper beds of the Coal-Measures of that region; but the object that had attracted especial attention was a brownish, smooth, oval-subglobose body, exposed on one side by breaking the mass from the parent rock.

At a first glance, this oval body seemed to present a startling resemblance to the upper surface of a large human skull. On a closer examination, however, although sutures were visible in it, they were seen to be very different from those of the human cranium. In other words, they were found to be the septal sutures of a gigantic shell of the genus *Goniatites*. As thus seen partly exposed, this shell measures six inches in breadth or convexity by about nine inches in its greater diameter. On breaking away portions of the enveloping rock, however, it soon became evident that there was still another volution outside of that first seen, thus increasing the convexity to about nine inches, and the greater diameter to about eleven inches. Yet this outer volution is septate as far as it can be traced in the rock; and as there must have been at least one-half of another turn, and possibly more, to form the outer non-septate chamber for the reception of the animal, I think we may safely infer that the greater diameter of this shell, when entire, must have been about sixteen inches, and possibly more. So far as I can remember, this would therefore be one of the largest, if not the largest, species of the genus *Goniatites* ever discovered. *G. Marcellensis*, and some other species, are said to have attained to the dimensions of twelve inches in their greater diameter; but these are discoid, and not subglobose shells, and consequently their convexity and entire volume are much less than the shell here under consideration.

So far as I have been able to determine, this shell agrees well in its septa and form with a large *Goniatite* from Kansas, figured by Mr. Worthen and the writer on page 390 of the second volume of the Illinois Geological Reports, and there referred to *G. globulosus*, M. & W. The type-specimens of that species were found in the Upper Coal-Measure near Springfield, Ill., and seem, so far as I am aware, rarely if ever to attain there a size of more than about one to two and one-fourth inches in their greater diameter.

The Kansas shell mentioned above, and that here under consideration, both agree very closely in form and their septa with the Illinois species; but, although mere differences of size are not generally reliable characters for the separation of species, the question naturally suggests itself, whether shells differing so *extremely* in size (the large being found in one district and the small in another) are really specifically the same? Although not fully satisfied that this may not be the case, it seems to me desirable that this huge Kansas shell should be at least viewed as belonging to a distinct variety. Consequently, I would propose to designate it as *G. globulosus* var. *excelsus*.

FOSSIL ORTHOPTERA FROM THE ROCKY MOUNTAIN TERTIARIES.

BY SAMUEL H. SCUDDER.

Homœogamia ventriosus.—The remains upon which this species is based consist of the apical portion of the ventral surface of a cockroach's abdomen found by Mr. T. L. Mead at Castello's ranch, South Park, Colorado. Five segments are seen in natural juxtaposition, showing that the apical portion of the abdomen was very regularly rounded, almost exactly semicircular; the terminal segment presenting no break in the regular continuity of the curve. This segment was ample, broader than long, and probably neither very tumid nor greatly keeled; for in the present perfectly flattened condition of the fossil there is neither break nor folding of the integument; the two segments following this are very strongly arched (the penultimate being semicircular) and greatly contracted at the middle, so that this portion is not less than half as long as the lateral parts; the anterior border of the antepenultimate segment is straight along the middle; the segment anterior to this is also arched, though not strongly, is oppositely sinuate (as are, to a less extent, the segments posterior to it), and also much contracted in the middle, so as to be less than half as long as at the sides; while its predecessor is slightly arcuate in the opposite direction (probably exactly transverse in life), and equal or subequal throughout. All the segments are uniformly, rather abundantly, and very delicately granulate throughout. There is no trace of cerci, but the place where they should occur is too broken to assert that they did not exist externally; still the conformation of this region would lead one to suppose that they must have been excessively minute, and perhaps altogether concealed within the segments, as in *Cryptocercus* Scudd.

Length of fragment, 8^{mm}; width of same, 12.25^{mm}; length of terminal segment, 3.6^{mm}; width of same, 6.3^{mm}; length of antepenultimate segment in the middle, 0.6^{mm}; at the sides, 1.85^{mm}.

I have referred this species to *Homœogamia* with some doubt; on some accounts, it would seem to be more nearly allied to *Polyphaga*, but, as the specimen is too fragmentary to allow of more exact determination, I have preferred to place it in the New World genus, rather than in its close ally, which is restricted to the Old World; possibly it should be referred to neither, but to a new group.

A great many fossil cockroaches have been found, mostly in the Carboniferous formation. Nearly all are described from tegmina. Only a few species have been discovered in the Tertiaries; and one of these, found in Parschlug in Steiermark, has been referred by Heer* to *Heterogamia*, a name used to include both *Polyphaga* and *Homœogamia*.

Labidura tertiaria.—A single fairly-preserved specimen (No. 1725) was found near Castello's ranch, South Park, Colorado, by Mr. Jesse Randall, and brought home by the United States Geological Survey of the Territories. The specimen is a female, as shown by the number of the abdominal segments. The head, which is badly preserved, is of about equal length and breadth behind the labrum, so that as a whole it is

*Heer, Insekt.Fauna Oening. ii, 1, pl. 1, fig. 1.

longer than broad, but it is slightly narrower than the pronotum, and has large eyes, reaching back nearly to the hind border—characters which are scarcely in keeping with the reference of the insect to *Labidura;* with no other genus, however, does it accord so well. The antennæ are too fragmentary to furnish us any clew to their structure, and of the mouth-parts nothing can be determined. The pronotum is of about equal length and breadth, quadrate, the anterior angles bluntly rounded, the posterior border very broadly convex, the margin nowhere elevated; there is a slight but distinct median sulcation, fading posteriorly. The rest of the thorax is of the same width as the pronotum; the tegmina are twice as long as the pronotum, squarely docked at the tip; the folded wings reach more than half as far again beyond the tip of the tegmina, and, in the specimen examined, are partially opened on the right side, so as to show incompletely the peculiar rayed arrangement of the nervules. The legs are short, the femora broadest in the middle, the tibiæ moderately slender and slightly bowed; but the tarsal joints are too obscure to determine their structure; the faintness of the legs probably shows that they were paler than the body, which is of a griseous brown. The joint of the abdomen can readily be distinguished, although a portion of some of them are injured, and especially of the third segment; this renders it impossible to decide certainly whether plications were present on this segment; but there are no signs of any, either on this or on the better-preserved second segment; it would seem as if such plications should be seen, if present, at least on the second segment; for the abdomen is preserved on a partial side-view, and the portion of the second segment where plications are to be looked for is perfectly preserved. The abdomen appears to have been equal as viewed from above, although the greater fullness in depth of the middle joints gives the specimen preserved on a partial side-view a great height in the middle; the last segment is large, scarcely narrowing, and furnished with a pair of stout, straight, tapering, bluntly-pointed forceps as viewed from the side, not so long as the tegmina, and apparently curved inward at the tip. The insect is slightly smaller than the common *L. riparia* (Pall.) Dohrn.

Entire length of specimen, 19.5^{mm}; length of head, 2.2^{mm}; breadth of same, 1.75^{mm}; length of pronotum, 1.9^{mm}; breadth of same, 2^{mm}; length of tegmina, 3.6^{mm}; extent of folded wings beyond tegmina, 2.5^{mm}; length of hind femora, 2.75^{mm}; of hind tibiæ, 1.75^{mm}; of forceps, 2.5^{mm}.

Fossil earwigs are not unknown, but have been imperfectly studied. Heer gives woodcuts of two, *Forficula recta*, which he compares with *Forcinella annulipes* (Luc.) Dohrn, and *F. primigenia*, compared with the common earwig, *i. e.*, *Forf. auricularia* Linn.; he also mentions a third, *F. minuta*, compared with *Labia minor* (Linn.) Leach. These all come from the Miocene of Oeningen.* Long ago, Serres spoke of a species allied to *Forficula parallela* Fabr. and *F. auricularia* Linn. (both the same species), of which many specimens had been found at Aix in Provence.† Perhaps Mr. Oustalet, in his forthcoming memoirs on the fossil insects of Southern France, will acquaint us more perfectly with this insect; but I saw no specimens of *Forficulariæ* in his hands in 1873. One or two species are also reported from Prussian amber. Burmeister says that the Berlin Museum possesses a specimen "having short filiform antennæ, composed at most of sixteen joints, gradually increasing

* Heer, Urwelt der Schweiz, 367, figs. 226–227.
† Serres, Géognosie des terrains tertiaires, 225.

in size, and a short, straight ovipositor [forceps]. It is of the size of *Forficula minor*, but is still a larva."* And Germar writes that, up to 1856, but a single specimen of an earwig had been found in amber, a larva, agreeing so completely with the full-grown larva of *Forf. auricularia* that description and illustration are superfluous.† The full-grown larva of *F. auricularia*, however, has but fourteen, and even the perfect insect but fourteen or fifteen, joints in its antennæ; and the forceps are neither short nor straight, but nearly as long as the abdomen, and incurved at the tip. It would seem probable, therefore, that these authors were writing of different insects, and that Germar overlooked Burmeister's statement. Gravenhorst, also, is said to refer to a German species from amber; but I have not yet been able to examine the reference to it. Finally, Massalongo describes and figures‡ a species from the Tertiaries of Monte Bolca, which he calls *Forficula bolcansis*, and which again he compares to *F. auricularia* Linn. This species, which in point of fact is much nearer *F. albipennis* Muehlf. than *F. auricularia*, is even more perfect than ours, and seems to be a true *Forficula*. The same may probably be said of Heer's species, or at least of the two which are figured (none are described); but in these cases we have only a few abdominal joints and the forceps from which to draw any conclusion. It is by no means improbable that the two insects figured by Heer are different sexes of the same species.

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* Burmeister, Handb. of Entom., Engl. trans., 579.
† Berendt, Org. Reste in Bernstein, ii, i, 33.
‡ Massalongo, Strid. Pal., 15-16, pl. 1, figs. 5-7.

STUDIES OF THE AMERICAN FALCONIDÆ.

By Robert Ridgway.

MONOGRAPH OF THE POLYBORI.

INTRODUCTION.

The *Polybori* are a group of American hawks of very peculiar appearance and habits, and without near relatives in any other portion of the world. Feeding largely upon carrion, while many of the species have the head partly denuded of feathers, most authors have assigned them a position near, or even amongst, the Vultures; but recent investigations have proven that, while they are true *Falconidæ*, they are at the same time not only widely different from the American Vultures (a very distinct family—the *Cathartidæ*), but closely related to the Falcons proper, to whose subfamily they belong, instead of that in which the Old-World Vultures are placed.

We have elsewhere demonstrated that the *Falconidæ* are divisible into but two subfamilies, the *Falconinæ* and the *Buteoninæ*, to the former of which belong the true Falcons, besides the genera *Micrastur* and *Herpetotheres*, and the subjects of the present paper; while to the latter belong the Old-World Vultures *and all other Falconidæ*.*

The characters defining the two primary divisions of the family, and which constitute them separate subfamilies, are more internal than external, so that they can be distinctly diagnosed by the osteological structure alone. The following diagnoses may serve for illustration of these wide differences.

A.—Scapular process of the coracoid produced forward so as to meet the clavicle. Nasal bones almost completely ossified, the nostril being a small, usually circular, opening, with a conspicuous, usually central, bony tubercle. Inferior surface of the supramaxillary with a prominent median angular ridge. Superciliary process of the lachrymal consisting of a single piece..Subfamily *Falconinæ*.

B.—Scapular process of the coracoid *not* produced forward, but separated from the clavicle by a wide interval. Nasal bones very incompletely ossified, the nostrils large, without bony tubercle, and frequently with an incomplete septum. Inferior surface of the supramaxillary without median ridge. Superciliary process of the lachrymal usually consisting of two pieces, joined by a cartilaginous hinge........................Subfamily *Buteoninæ*.

The subfamily *Falconinæ* is composed of four well-defined groups, the *Falcones*, *Polybori*, *Micrastures*, and *Herpetotheres*, which are distinguished as follows:

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* See "Outlines of a Natural Arrangement of the Falconidæ," in Bull. No. 4, second series, pp, 225–231, pls. xi–xviii.

A.—Posterior toe abbreviated, very much shorter than the lateral pair; tarsi and toes covered with small hexagonal scales, larger in front.

a. Nostril a small, round, or oblique opening, with a bony-rimmed margin and central tubercle.

1. Superior tomium with a conspicuous tooth, and inferior tomium with a corresponding notch. Superciliary process of the lachrymal elongated, narrow, reaching nearly across the orbit. Posterior margin of the sternum nearly even, with a pair of large oval foramina. One or two outer primaries with their inner webs emarginated near their tips. Group 1, *Falcones.*

2. Tomia without tooth or notch.*
Superciliary process of the lachrymal abbreviated, reaching only half-way across the orbit. Posterior margin of the sternum with a pair of deep indentations. Three or more outer primaries with their inner webs sinuated near the middle portion......................... Group 2, *Polybori.*

b. Nostril a large opening without bony-rimmed margin or central tubercle.

3. Superciliary process of the lachrymal elongated, broad, extending nearly across the orbit. Tomia without tooth or notch. Posterior margin of the sternum as in *Falcones.* Four or more outer primaries with inner webs sinuated near the middle portion.................. Group 3, *Micrastures.*

B.—Posterior toe elongated, almost equal to the lateral pair. Tarsi and toes covered uniformly with thin, rough, imbricated scales.

4. Tomia without tooth or notch. Nostril as in *Falcones* and *Polybori.* Superciliary process of the lachrymal elongated, very broad, reaching nearly across the orbit. Posterior margin of the sternum nearly even, entire, and without foramina. Primaries as in *Polybori* and *Micrastures.* Group 4, *Herpetotheres.*

Genera of POLYBORI.

A.—Tarsus $\frac{1}{2}$–$\frac{2}{3}$ its length longer than the middle toe; outer toe but little longer than the inner; posterior toe very decidedly shorter than the inner. Inner webs of primaries deeply sinuated. Habits chiefly terrestrial.

a. Nostril linear, obliquely vertical, its tubercle concealed; anterior outline of the cere vertical and nearly straight.

1. POLYBORUS.—Nostril linear, obliquely vertical, its posterior end the upper one; situated in the upper anterior corner of the cere. Occipital feathers elongated into a depressed crest.

b. Nostril circular, in the middle of the cere, its tubercle exposed; anterior outline of the cere doubly curved.

2. PHALCOBÆNUS.—Tooth and notch of the tomia of the bill nearly obsolete; lower jaw nearly naked; outer toe not appreciably longer than the inner; posterior toe reaching much beyond the first joint of the middle toe; claws remarkably blunt, slightly curved; posterior face of the tarsus without distinct rows of quadrate scales; upper tail-coverts remarkably developed, covering nearly two-thirds the tail; size large.

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* Though faint indications of these are observable in some genera (*Milvago* and *Phalcobænus*) in the horny sheath, they cannot be detected in the bones of the bill.

3. MILVAGO.—Tooth and notch of the tomia of the bill distinctly indicated; lower jaw normally feathered; outer toe decidedly longer than the inner; posterior toe not reaching the first joint of the middle toe; claws sharp, strongly curved (as in the *Falcones*); posterior face of the tarsus with two distinct rows of quadrate scales. Upper tail-coverts normal, covering about one-third the tail; size small.

B.—Tarsus scarcely longer than the middle toe; outer toe very much longer than the inner, which is but little longer than the posterior one. Inner webs of primaries shallowly sinuated. Habits strictly arboreal.

4. IBYCTER.—Nostril circular, near the middle of the cere, its tubercle either concealed or exposed; anterior outline of the cere doubly curved. Tarsus without transverse scutellæ either in front or behind.

Geographical distribution.

The *Polybori* are most numerous in South America, only four of the eleven known species being found north of Panama; and of these, one (*Milvago chimachima*) finds its northern limit in Veragua, while another (*Ibycter americanus*) extends no farther northward than Guatemala and Honduras. The remaining two extend northward only to the limits of the subtropical country, or to about latitude 30°; *Polyborus cheriway* being more or less abundant along the southern border of the United States, from Southern California to Florida, as well as throughout Middle America, thence southward, and also on the islands of Socorro and Tres Marias, off the western coast of Mexico, and in Cuba; *P. lutosus* is restricted to the Guadalupe Islands, off the coast of Lower California, between latitude 28° 45′ and 29° 10′ north. In South America, the range of the group is much more extensive, every portion of the continent, even to its extreme southern limits, being inhabited by one or more of the species. According to the distribution of these birds, the region inhabited by them may be divided into the following "provinces" and "districts."

A.—NORTHERN PROVINCE—embracing the whole of Middle America north to about 30°, and also that portion of South America comprised by the states of Ecuador, New Granada, Venezuela, and Guiana, and the northern drainage of the Amazon. It comprises—

a. Continental District, including the whole excepting the Guadalupe Islands; and

b. Guadalupe District, embracing the islands of Guadalupe alone.

B.—SOUTHERN PROVINCE—embracing all of South America south of the Amazon and Ecuador. It comprises—

a. Atlantic District, or the entire area drained by the rivers flowing into the Atlantic;

b. Magellan District, or the country adjacent to the Straits of Magellan, embracing Tierra del Fuego, Falkland Islands, and the eastern slope of Patagonia;

c. Southern Pacific District, or the narrow Pacific slope, from Patagonia northward to Peru; and

d. Northern Pacific District, a continuation of the former northward to Colombia.

According to this arrangement, the species are distributed as follows:

Name of species.	Northern Province.		Southern Province.			
	Guadalupe District.	Continental District.	Atlantic District.	Magellan District.	Pacific District.	Colombian District.
Polyborus tharus			*	*	*	
lutosus	*					
cheriway		*				*
Phalcobænus megalopterus					*	
carunculatus						*
albigularis				*		
Senex australis				*		
Milvago chimango			*	*	*	
chimachima		*	*			*
Ibycter americanus		*	*			*
Daptrius ater			*			

Genus POLYBORUS, Vieillot.

Polyborus Vieill. Analyse, 1816, 22 [type *Falco brasiliensis* Gmel.=*P. tharus* (Mol.)].
Caracara Cuvier, Reg. Anim. 1817 [same type.]

Osteology.—Skull most like that of *Phalcobænus*, but premaxillaries more compressed, dome of the cranium flatter and more horizontal, and the nasal bones and palatines of different form. Nostrils closely approximated in the upper edge of the nasals, oblong and oblique, their upper end being the posterior one. Posterior outline of the palatines nearly truncated, with the postero-lateral outline forming an abrupt angle; mandible with an acute-oblong vacuity posterior to the middle portion. Length of skull, 3.30–3.35 (1.60–1.65); breadth, 1.55–1.60; depth, 1.20–1.25.*

Posterior margin of the sternum with a pair of widely-separated, very deep, rounded indentations. Tarsus : tibia=3.50 : 4.50.

Pterylosis.†—Remiges, 24. Lores, orbital region, cheeks, lower jaw, and chin naked, with very scant fine bristles; the skin brightly colored (red or yellow) in life; entire cere behind and below the nostril, scantily covered with fine hairs. Entire pileum densely covered with well-developed normal feathers, those of the occiput elongated into a tolerably lengthened, depressed crest; feathers of the nape also well developed. Contour-feathers compact. Remiges well developed, the primaries nearly twice the secondaries, hard, stiff, the third to fourth longest, the first shorter than sixth or seventh; inner webs of outer four distinctly, and the fifth just perceptibly, sinuated. Tail about two-thirds the wing, slightly rounded, or nearly even, the webs firm and shafts strong.

General external features.—General aspect somewhat vulturine, but bearing and manners almost gallinaceous. Neck and legs very long. Bill very high and much compressed, the commissure very straight and regular, and nearly parallel with the superior outline; cere very narrow, its anterior outline vertical and straight. Nostril very small, linear, obliquely vertical, its upper end being the posterior one; situated in the upper anterior corner of the cere. Feet almost gallinaceous in appear-

*The number in parentheses denotes the length of the premaxillary alone from the point to the beginning of the frontal.

†Nitzsch (p. 63) says that the distribution of the feather-tracts in the *Polybori* is much the same as in the *Buteones*. *Polyborus* is said to differ from the other genera of the group "in having the dorsal portion of the spinal tract elliptically dilated upon the caudal pit, where it incloses a narrow lanceolate insular space—a structure which I have never met with elsewhere among the Falcons."

ance, the tarsus being almost twice the middle toe in length; outer toe longer than the inner; posterior much the shortest. Claws normal, but rather long, and only slightly curved. Tarsus with large scutellæ in front, the lower four to six forming a single frontal row, continuous with the scutellæ of the top of the toes, the rest arranged in two paralle series of alternating hexagonal, longitudinal scales; those on the pos terior face smaller, more nearly quadrate, and arranged in two longi tudinal series.

Species of POLYBORUS.

COMMON CHARACTERS.—*Adult:* Whole pileum, the body and wings in general, and terminal zone of the tail dull black or dark brown. Cheeks, neck, jugulum, tail-coverts, and tail dull white or light isabella-color; nape, interscapulars, and breast with transverse bars of the two colors mixed; tail with narrow transverse bars of grayish.—*Young:* Black replaced by dull brown; transverse bars of the neck and breast replaced by longitudinal stripes. Tail similar.

Species.

A.—Rump and tail-coverts white, with or without bars; tail white, with narrow bars of grayish-brown, and a terminal zone of black 2.00 inches or more wide.

1. P. CHERIWAY.—Whole body and middle wing-coverts uniform black (*adult*) or brown (*young*); tail-coverts without bars; terminal zone of the tail about 2.50 wide. Wing, 14.60–16.50; tail, 8.80–10.00; culmen, 1.20–1.48; tarsus, 3.20–3.75; middle toe, 1.90–2.10. *Hab.*—Northern Tropical America, from Ecuador and Northern Amazonia to southern border of the United States, including the entire border from Southern California to Florida; Cuba.
2. P. THARUS.—Whole body and middle wing-coverts transversely barred (*adult*) or striped (*young*); tail-coverts barred; terminal zone of tail about 2.00 wide. Wing, 16.00–17.70; tail, 10.00–11.00; culmen, 1.20–1.41; tarsus, 3.70–4.20; middle toe, 1.75–2.30. *Hab.*—South America, from Amazonia southward.

B.—Rump and tail-coverts light isabella-color, with broad brown bars; tail light isabella-color, with broad bars of grayish-brown bordered by zigzag, narrow bars of dusky; terminal zone less than 2.00 inches wide.

3. P. LUTOSUS.—Lower parts entirely light isabella-color, with transverse bars (*adult*) or longitudinal stripes (*young*) of dark brown, except on throat and cheeks; scapulars plain brown. Terminal zone of tail, 1.00–1.60 wide; wing, 15.00–16.40; tail, 10.50–11.65; culmen, 1.25–1.35; tarsus, 3.50–3.75; middle toe, 1.80–2.10. *Hab.*—Guadalupe Islands.

POLYBORUS THARUS.

SOUTHERN CARACARA.

Falco tharus MOL. Sagg. St. Nat. Chile, 1782, 264.—GM. S. N. i, 1788, 254.—LATH. Index Orn. i, 1790, 16; Syn. Supp. ii, 18; Gen. Hist. i, 243.—DAUD. Tr. Orn. ii, 1800, 41.—SHAW, Zool. vii, 1812, 170.

Polyborus tharus STRICKL. Orn. Synon. i, 1855, 19 (part).—GURNEY, Cat. Rapt. Norw. Mus. 1864, 17.—SCL. & SALV. Ibis, iv, 1868, 187 (Gregory Bay, Str. Magellan, May–Feb.); P. Z. S. 1869, 252 (Maruria, Venezuela); ib. 634 (Conchitas, Resp. Argent.); Nomencl. Neotr. 1873, 123.—GRAY, Hand List, i, 1869, 17.—RIGW. Pr. A. N. S. Philad. 1870, 145; Pr. Boston Soc. May, 1873, —; in B. B. & R. Hist. N. Am. B. iii, 1874, 177 (foot-note).—HUDSON, P. Z. S. 1872, 534 (Rio Negro, Patagonia).—SHARPE, Cat. Acc. Br. Mus. 1874, 31.

Falco plancus GM. S. N. i, 1788, 257.
Vultur plancus LATH. Ind. Orn. i, 1790, 8.
Falco brasiliensis GM. S. N. i, 1788, 263.—MAX. Beitr. iii, 1830, 190.
Polyborus brasiliensis VIG. Zool. Journ. i, 1824, 320.—SWAINS. Zool. Illustr. ser. 2, 1832, pl. 2.—GOULD, Zool. Beag. 1841, 9.—BONAP. Consp. i, 1850, 13.—PELZ. Verh. z.-b. Ges. Wien, 1862, 137; Orn. Novara, 1865, 6 (Chili); Orn. Bras. i, 1871, 293.—SCHLEG. Mus. P.-B. (Polybori,) 1862, 2 (part).
Circaëtus brasiliensis CUV. Règ. An. i, 1829, 328.
Vultur cheriway, LATH. Ind. Orn. i, 1790, 8 (not of JACQ., 1784).
Falco cheriway LICHT. Verz. Doubl. 1823, 60.
Aquila cheriway MEYEN, Beitr. 1834, 66.
Polyborus vulgaris SPIX, Av. Bras. i, 1824, 3, pl. 1.—VIEILL. Gal. Ois. i, 1825, 23, pl. 7.—LESS. Tr. 1831, 34.—D'ORB. Voy. Am. Merid. Zool. 1835, 55.—TSCHUDI, F. Per. 1845, 77.—BURM. Th. Bras. ii, 1856, 41.
Caracara vulgaris LESS. Tr. Orn. 1831, 34.
Pandion caracara G. R. GRAY, in Griff. ed. Cuv. An. Kingd. vi, 1829, 235.
Caraçará, MARCGR. Hist. Bras. 1648, 211.—AZARA; Pax. Par. i, 1802, 42, No. 4.
Le Busard du Brésil BRISS. Orn. i, 1760, 405.
Plaintive Eagle LATHAM, Synop. i, 34 (adult); Supp. 4.

Hab.—Southern South America, north to Amazonia. Paraguay, Chili, and Patagonia, NAT. MUS.—Tierra del Fuego, Straits of Magellan, Hermit Island, Island of Mexiana, and Rio de Janeiro, SHARPE, l. c.—Pacific coast north to latitude 20° south, *fide* SHARPE, l. c.

Descriptions.

Adult male (21,850, South America; T. R. Peale).—Pileum and wings brownish-black; middle wing-coverts browner, with indistinct whitish bars; primaries white in the middle (just beyond the coverts), this portion having indictinct washes of grayish, in form of faintly-indicated transverse bars; basal three-fourths of the tail white, with numerous narrow, washed bars of grayish, these becoming more faint toward the base; tail with a terminal zone of black, about two inches broad. Cheeks, chin, and throat soiled white, unvaried; body in general (including neck, breast, sides, abdomen, back, and scapulars) transversly barred with black and white, the white prevailing anteriorly; beneath, the black bars grow gradually wider posteriorly, giving the tibiæ and femorals a uniformly blackish appearance; on the back and scapulars also, the black bars exceed the white in width, but they are very sharply defined, regular, and continuous; rump, upper and lower tail-coverts, white, with numerous faint bars of grayish. Under side of the wing black; outer six primaries white in the middle portion, beyond the coverts, this patch extending obliquely across; secondaries rather broadly barred on basal two-thirds with black and white, leaving the terminal third unvaried. Third quill longest; fourth scarcely shorter; second intermediate between fifth and sixth; first a little longer than seventh. Wing, 16.00; tail, 6.50; tarsus, 3.50; middle toe, 1.75.

Young (13,923, South America; T. R. Peale).—Forehead, crown, occiput, nape, back, wings, and lower parts dark sepia-brown; feathers of the breast, sides, and abdomen marked centrally with a broad longitudinal stripe of soiled fulvous-white; those of nape and back more indistinctly striped, and variegated irregularly at ends with the same; wing-coverts passing terminally into pale brownish; secondaries obscurely barred with the same. Cheeks, chin, and throat unvariegated soiled white; tibial feathers with shaft-stripes of pale fulvous. Rump, tail-coverts, and tail as in adult.

Remarks.

Several specimens from Buenos Ayres (Conchitas; Wm. H. Hudson) and one from Paraguay (59,236; T. J. Page, U. S. N.) have the black

of the lower part of the abdomen and flanks quite continuous. There is never, however, in South American specimens, an approach to the peculiar characters *P. cheriway*, as defined.

List of specimens in United States National Museum.

Catalogue No.	Corresponding No. of.	Original No.	Sex and age.	Locality.	When collected.	From whom received.	Nature of specimen.
13923	......	......	Young..	South America........	....	Exploring expedition......	*S.
13924	......	......	Adult...	......do	....	......do..................	S.
13925	......	......	♂	......do	....	......do..................	S.
13926	2	3	Adult...	Patagonia..............	....	......do..................	S.
13929	......	......	Adult...	Chili..................	....	Lieutenant Gilliss.........	S.
21850	......	......	♂ adult	South America........	....	......do..................	S.
48802	......	4	....	Chili..................	....	National Museum, Chili...	†M.
48803	......	4	....	......do	....	......do..................	S.
59238	......	2	....	Paraguay	....	Captain Page..............	S.

*S—Unmounted skin. †M—Mounted skin.

Other specimens examined.

Mus. Boston Soc. Nat. Hist., 4; Mus. Philad. Acad. Nat. Sci., 3; Am. Mus. N. Y., 3—total, 19.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂	16.00–17.20	10.00–11.00	1.20–1.30	3.70-3.90	1.75–2.15	2
♀	17.70	10 00	1.41	4.20	2.30	1
?	15.50	10.00	1.30	3.65	1.90	Smallest of 4

POLYBORUS CHERIWAY.

NORTHERN CARACARA.

Falco cheriway JACQ. Beitr. 1784, 17, tab. 4.—GM. S. N. 1788, 254, No. 40 (*Juv.*).

Polyborus cheriway CABAN. in Schomb. Reise Guiana, iii, 1848, 741.—BREWER, Pr. Boston Soc. vii, 1860, 305 (Cuba).—SHARPE, Cat. Acc. Br. Mus. 1874, 33.—GURNEY, Ibis, Jan. 1875, 95 (Brazil).

Polyborus brasiliensis AUDUB. B. Am. fol. 1831, pl. 161; octav. ed. i, 1839, 21, pl. 4 (nec VIG. 1824 ex GM. 1788).—BREWER, Pr. Boston Soc. vii, 1860, 305 (Cuba).—TAYLOR, Ibis, vi, 1864, 79 (Trinidad).—ALLEN, Bull. Mus. Comp. Zool. ii, 1871, 337 (Florida).

Polyborus vulgaris AUD. Orn. Biog. ii, 1834, 350 (nec SPIX, 1824).—BREWER, Pr. Boston Soc. vii, 1860, 305 (Cuba).

Polyborus tharus CASS. B. Cal. Tex. &c. 1854, 113 (nec STRICKL. 1855 ex MOL. 1782); B. N. Am. 1858, 45.—BREWER, N. Am. Oöl. i, 1857, 58, pl. xi, figs. 18, 19; Pr. Boston Soc. vii, 1860, 305 (Cuba).—HEERMANN, Pacif. R. R. Rep. vii, 1857, 31.—SCLATER, P. Z. S. 1857, 210 (Orizaba).—OWEN, Ibis, iii, 1861, 67.—GURNEY, Cat. Rapt. Norw. Mus. 1864, 17 (part).—DRESSER, Ibis, 1865, 329 (Texas).—COUES, Pr. A. N. S. Philad. 1866,—(Arizona).—SCL. & SALV. P. Z. S. 1870, 838 (coast of Honduras).

Polyborus auduboni CASS. Pr. A. N. S. 1865, 2 (Texas and Mexico).—LAWR. Ann. N. Y. Lyc. ix, 1868, 132 (Costa Rica).—COOPER, Orn. Cal. i, 1870, 492.—RIDGW. Pr. A. N. S. Philad. Dec. 1870, 145.—GUNDL. J. für Orn. 1871, 357.—ORTON, Am. Nat. v, 1871, 624 (Quito Valley).—GRAYSON, Pr. Boston Soc. 1871, 9 (Tres Marias).—SCL. & SALV. Nom. Neotr. 1873, 123.

Polyborus tharus var. *auduboni* COUES, Key, 1872, 220.—RIDGW. Pr. Boston Soc, 1873, 11; in B. B. & R. Hist. N. Am. B. iii, 1874, 178.—LAWR. Mem. Bost. Soc. ii. 1874, —(biography).

Hab.—Middle America and adjoining portions of North and South America, from southern border of United States to Ecuador and Guiana. Louisiana, Texas, and Lower California, NAT. MUS.—Florida, AUDUBON *et* AUCT.—Puna Island, Guayaquil, Ecuador, NAT. MUS.—Venezuela (Valencia) and British Guiana, SHARPE, l. c.—Brazil, GURNEY, l. c.

Descriptions.

Adult male (12,016, Texas; Captain McCall.)—Forehead, crown, occiput and nape, wings, scapulars, rump, belly, thighs, and anal-region continuous deep dull black; chin, neck, jugulum, breast, and tail-coverts (upper and lower) soiled white. Breast with numerous cordate spots of black, these growing larger posteriorly, and running in transverse series; back with transverse bars of white, which become narrower and less distinct posteriorly. Basal two-thirds of tail white, crossed by thirteen or fourteen narrow transverse bands of black, which become narrower and more faint basally; outer web of lateral feather almost entirely black; broad terminal band of the tail uniform black (2.40 inches in width); third, fourth, fifth, and sixth primaries grayish just beyond the coverts; this portion with three or four transverse bars of white. Middle portion of primaries beneath faintly barred with white and ashy; the barred portion extending obliquely across. Third quill longest, fourth a little shorter, second shorter than fifth; first 3.60 inches shorter than longest. Wing, 16.70; tail, 9.60; tarsus, 3.40; middle toe, 2.10.

Adult female.—Plumage similar; white more brownish; abdomen with indication of bars. Wing, 15.50; tail, 8.70; tarsus, 3.30; middle toe, 2.20.

Young (42,130, ♀, Mirador, Mexico; Dr. C. Sartorius).—Black of adult replaced by dingy dark brown, this darkest on the hood; white and dusky regions gradualy blended, the feathers of the breast being whitish, edged (longitudinally) with brown. No trace of the transverse bars, except on the tail, which is like that of the adult. Bill whitish, bluish, or purplish at the base; cere white; feet ashy-white; claws black.

List of specimens in United States National Museum.

Catalogue number.	Corresponding No. of—	Original number.	Sex and age.	Locality.	When collected.	From whom received.	Nature of specimen.
4122	......	......	Adult..	Monterey, Mexico		Lieutenant Couch	S.
4248	1	......	....	Calcasieu Pass, La	—— —, 1854	G. Würdemann	S.
7994	......	......	....	Mexico	Sept. 30, ——	Jno. Gould	S.
9136	......	......	....	Texas		Maj. W. H. Emory	S.
9137	......	......	....	New Mexico		Dr. T. C. Henry	S.
12016	......	......	♂	Texas		Captain McCall	M.
16928	......	......	♂	Cape St. Lucas	Sept. 18, ——	J. Xantus	S.
17220	......	2476	♀	do	Dec. 2, 1859	do	S.
17221	......	2473	♂	do	Nov. 25, 1859	do	S.
17222	......	2472	♂	do	do	do	S.
29454	......	4043	....	Lower California (San José)		do	S.
29527	......	2841	....	Costa Rica (San José)		Berlin Museum	S.
33206	......	......	....	do	Jan. 19, 1864	J. Carmiol	S.
37871	......	136	....	Yucatan (Merida)	Jan. 20, 1865	José Salazar	S.
37872	......	142	....	do	Feb. 2, 1865	do	S.
39171	......	555	♀ juv.	do	June 9, 1865	do	S.
39172	......	341	♂ juv.	do	Mch. 31, 1865	do	S.
40955	......	......	....	Nicaragua (Chimandega)		Professor Hopkins	S.
40986	......	......	....	do		F. Hicks	S.
42130	......	210	♀ juv.	Mexico (Mirador)		Dr. C. Sartorius	S.
46795	......	849	....	Texas (Laredo)	Jan. 10, 1867	Dr. H. B. Butcher	S.
46796	......	848	....	do	do	do	S.
47562	......	......	....	Costa Rica (San José)	Aug. 30, 1866	J. Carmiol	S.
51321	......	......	♀	Mexico (Mazatlan)	Dec. —, 1867	F. Bischoff	S.
51322	......	......	♀	do	do	do	S.
51323	......	......	....	do	do	do	S.
51324	......	......	♂	do	Mar. —, 1868	do	S.
51325	......	......	♂	do	do	do	S.
52826	......	661	♂	do		Col. A. J. Grayson	S.
54934	......	42	....	Ecuador (Guyaquil)		Dr. Destruge	S.
59938	......	4457	♂ ad.	Cape St. Lucas		J. Xantus	S.
59939	......	2507	♀ juv.	do		do	S.
59940	......	50	....	Guyaquil		Will. Coll. Lyc	
59941	......	......	....	Cape St. Lucas		J. Xantus	

Other specimens examined.

Mus. Boston Soc., 2; Philad. Acad., 4; Comp. Zoology, 1; G. N. Lawrence, 1; R. Ridgway, 2—total 44.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	Specimens.
♂	14. 60–16. 50	9. 00–10. 00	1. 20–1. 48	3. 20–3. 60	1. 90–2. 00	6
♀	14. 75–16. 00	8. 80–10. 00	1. 20–1. 45	3. 55–3. 75	2. 00–2. 10	8

Fresh measurements.

No.	Total length.	Expanse.	Remarks.
4122	23. 50	47. 25	Bill very light olive; feet yellow.
16928	23. 50	53. 00	
17220	22. 50	50. 50	
17221	22. 70	50. 00	
17222	23. 00	51. 00	
29454	24. 00	48. 00	
33206	23. 50	44. 00	Iris yellow.

POLYBORUS LUTOSUS.

GUADELUPE CARACARA.

Polyborus Lutosus RIDGWAY, n. s.

Hab.—Guadelupe Islands, Lower California [E. PALMER].

SP. CH.—Wing, 15.00–16.40; tail, 10.50–11.65; culmen, 1.25–1.35; tarsus 3.50–3.75; middle toe, 1.80–2.10.

Adult.—Pileum, lesser wing-coverts, secondaries, primary-coverts, alula, terminal portion of primaries, entire lining of the wing (including axillars), and terminal band on the tail (1.00–1.60 wide) blackish-brown, sometimes almost black; auriculars, cheeks, and throat dirty whitish or light isabella-color. Rest of the plumage marked with transverse bars of brownish-black or dark brown, and brownish-white or light isabella-color; the bars most regular on the lower surface (and often the upper tail-coverts), where they extend uninterruptedly from the fore neck to the crissum, the bars of the two colors being about equal in width, the dark ones fainter on the crissum, narrower and more distant on the fore neck; on the middle and greater wing-coverts, they are similar to those on the abdomen; on the interscapulars, the dark ones are much wider than the light ones, and nearly black; on the scapulars, dark brown prevails, the lighter bars being almost obliterated. The basal half or more of the outer five or six primaries are isabella-white, transversely mottled, or raggedly barred, with grayish and dusky, the shafts clear yellowish-white. Tail, except dusky terminal band, marked with ragged transverse bars of brownish-gray and isabella-white, of equal widths; the bars of the two colors separated by a narrower zigzag bar of dusky.

Young.—Remiges and rectrices the same as in the adult, but the terminal band of the tail narrower and less sharply defined; pileum and lesser wing-coverts dark brown, the feathers with lighter brown edges (these sometimes worn off); back and scapular dull grayish-brown, the latter plain, the former usually slightly variegated with lighter borders and tips to the feathers. Lower parts light grayish-brown, with longi

tudinal dashes of dirty whitish; upper tail-coverts dull grayish-brown tipped with dirty whitish, and sometimes barred with the same, the feathers with darker shaft-streaks; lower tail-coverts very indistinctly marked in much the same manner. Auriculars, cheeks, and throat plain dirty whitish, as in the adult.

Chick.—General color light isabella-color, or brownish white, with an umber-brown patch over the scapula, and connected with one over the radius and ulna; pileum uniform umber-brown.

Remarks.

These specimens form part of a very interesting collection made by Dr Edward Palmer, a collector of the National Museum.

In the adult plumage, all the contour-feathers have distinctly black shafts, especially on the lower surface and upper tail-coverts; on the tibiæ and anal-region, the dark bars are smaller and more faint than elsewhere, and incline to a sagittate form; the feathers of the lining of the wing are sometimes narrowly tipped with light isabella-color or tawny brown, and the transverse bars are faintest and most confused on the upper portion of the rump. In both adult and immature stages, there is considerable variation, but all within the limits of the above diagnosis.

This species resembles the *P. tharus* much more than *P. cheriway;* but it is, nevertheless, so very distinct as not to need actual comparison. The tail is entirely different in its markings, the darker bars being much wider than the light ones (twice as wide) on the middle feathers, while each is bordered with a narrower zigzag bar of dusky; the lighter markings are, moreover, light isabella-color, instead of white, as in *P. tharus*, in which white forms the ground-color, over which cross very narrow bars of grayish-brown. The rump and upper tail-coverts are very indistinctly barred, brown being the prevailing color; while in *P. tharus* this region is white, narrowly barred with grayish-brown. The ground-color of the lower parts is light isabella-color, with imperfect, more or less sagittate, bars of brown, whereas in *P. tharus* these portions are black, crossed with narrow, regularly-transverse bars of brownish-white. The throat is light isabella-color, while in *P. tharus* it is white. Numerous other differences might be mentioned; but they are too numerous. Briefly, the more conspicuous differences between the three species may be contrasted as follows:—

P. LUTOSUS.—*Scapulars plain dusky brown. Tibiæ and flanks light isabella-color*, barred with dark brown. Wing-coverts (middle and greater) marked with wide bars of brown and pale isabella-color, of equal width. Tail-coverts and rump with broad bars of light isabella-color and grayish-brown. *Tail with broad bars of pale isabella-color and grayish-brown, separated by zigzag lines of dusky. Abdomen isabella-color*, with small sagittate bars of dark brown.

P. THARUS.—Scapulars barred grayish-white and black. *Tibiæ and flanks nearly uniform blackish-brown.* Wing-coverts brown, narrowly barred with whitish. *Tail-coverts and rump white, with narrow bars of grayish-brown. Tail white, with narrow bars of brownish-gray. Abdomen blackish-brown*, with transverse bars of whitish.

P. CHERIWAY.—Scapulars plain brownish-black. Tibiæ and flanks plain black. Wing-coverts plain blackish. *Tail-coverts and rump plain white* without bars. Tail as in *P. tharus. Abdomen plain black.**

* The characters in *italics* are those common to the adult and young plumages.

List of specimens in United States National Museum.

Nat. Mus. No.	Coll. No.	Sex and age.	Date (1875).	Wing.	Tail.	Culmen	Tarsus.	Middle toe.	Remarks.
69980	22	— juv.	....	15.75	11.25	1.30	3.70	1.95	No. 66989: "Eye brown; legs and cere dead white, with a bluish tinge." No. 66990: "Legs light yellow; cere, &c., salmon-color."
69981	30	♀ juv.	....	15.50	11.25	1.30	3.50	1.90	
69982	31	— ad.	....	16.00	10.80	1.35	3.70	2.00	
69983	32	— ad.	....	15.50	10.65	....	3.60	1.90	
69984	18	♀ ad.	May 10	16.40	11.65	1.30	3.65	2.10	
69985	25	— juv.	....	16.10	11.25	1.25	3.65	2.00	
69986	17	— juv.	....	15.80	10.75	1.25	3.60	2.05	
69987	23	— ad.	May 10	15.75	11.00	1.30	3.50	1.90	
69988	27	— juv.	....	15.50	10.50	1.30	3.65	1.90	
69989	21	♂ juv.	....	15.00	10.50	1.25	3.55	1.80	
69990	20	♂ juv.	....	15.50	11.00	1.30	3.65	2.05	
69991	33	♂ juv.	....	15.50	10.60	1.30	3.60	1.95	
69992	26	— ad.	....	15.80	11.00	1.30	3.50	1.95	
69993	24	♀ ad.	....	15.50	10.60	1.25	3.60	2.00	
69994	29	— juv.	....	15.50	11.00	1.30	3.75	1.90	
69995	19	— ad.	....	15.75	11.00	1.25	3.60	1.90	
69996	48	— pull.	May 10	....	....	....	....	....	
69997	48	— pull.	...do....	....	....	....	....	....	
69998	48	— pull.	...do...	....	....	....	....	....	
69999	34	— pull.	April 11	....	....	....	....	....	

GENUS PHALCOBÆNUS, LAFRESNAYE.

a. *Phalcobænus.*

Phalcobænus LAFR., in d'Orb. Dict. iii, 1843, 151. [Type, *Aquila megaloptera* MEYEN.]

β. *Senex.*

Senex J. E. GRAY, in Jard. & Selby Ill. Orn., n. s. 1839, pl. 24. [Type, *Falco australis* GMEL.]

Ætriorchis KAUP, Class. Säug. Vog. 1844, 124. [Same type.]

Helotriorchis REICH. Av. Syst. Nat. 1850, pl. xcviii. [Same type.]

Osteology (of *P. australis* *).—Compared with that of *Polyborus*, the skull is quite similar, but is relatively both broader than higher, and the nostrils entirely different, being circular and central. Premaxillary much less compressed throughout; frontal less turgid anteriorly, more inflated, and with a deep median valley posteriorly; lachrymals relatively and absolutely much smaller; intermastoid width of the skull much greater; posterior outline of the palatines gently rounded. Length of skull, 3.60 (1.90); breadth, 1.80; height, 1.30.

Pterylosis.—Wing large, the primaries stiff and rather narrow, with hard shafts; third or fourth quill longest; outer four or five with inner webs sinuated (almost emarginated on the outer); remiges, 25 (in *P. megalopterus*). Tail about three-fifths the wing, very slightly rounded or almost even, the feathers broad, with firm webs and strong shafts. Plumage in general full and rather soft (in the young very soft and downy); loral and maxillary regions more or less naked, with scattered bristles; tibial plumes well developed.

General external characters.—General form and appearance of *Polyborus.* Bill less compressed, and culmen more gradually curved, the tip shorter; tomia very slightly lobed, and with the notch and tooth obsolete. Nostril circular, central, and rimmed. Tarsus $1\frac{1}{2}$ to $1\frac{2}{3}$ times the length of the middle toe; lateral toes about equal; the anterior toes all webbed, the outer well developed, the inner very slight;

* Of this genus, we have only the skull of this single species.

claws very slight curved, remarkably blunt, light-colored. Tarsi covered chiefly with hexagonal scutellæ, its lower portion with a frontal series of about 3–6 large transverse plates, the posterior face with a longitudinal series of scales rather larger than the smaller ones in front.

The genus *Phalcobœnus* comprises two well-marked subgenera, distinguished as follows:

a. Frontal feathers (of adult) recurved, very soft, lanceolate; loral and maxillary regions naked; fore neck feathered. In the adult, the abdomen, anal region, crissum, upper tail-coverts, and lining of the wing white; secondaries and tail tipped with white; other parts deep black .... *Phalcobœnus.*

β. Frontal feathers pointed backward (normally), stiff and lanceolate; lower jaw and lores densely covered with strong bristles; fore neck naked. In the adult, abdomen and anal region ochraceous; crissum and upper tail-coverts black; lining of the wing and tibæ black mixed with ochraceous; breast and nape longitudinally streaked with dingy whitish; secondaries not tipped with white...... *Senex.*

Species of PHALCOBÆNUS.

A.—*Skin of lower jaw developed into a slightly pendant wattle.*

1. P. CARUNCULATUS.—Jugulum and breast black, with broad, longitudinal streaks of white. Wing, 14.70; tail, 9.00; culmen, 1.25; tarsus, 2.80; middle toe, 1.60. *Hab.*—Ecuador and New Granada.

B.—*Skin of lower jaw not developed into a wattle.*

2. P. MEGALOPTERUS.—Jugulum and breast black, without white streaks. Wing, 14.20–16.00; tail, 9.20–10.00; culmen, 0.95–1.20; tarsus, 3.05–3.60; middle toe, 1.50–1.70. *Hab.*—Chile, Bolivia, and Peru (Pacific slope).
3. P. ALBIGULARIS.—Jugulum and breast white. Wing, 15.00; tail, 9.30; culmen, 1.65; tarsus, 3.10. *Hab.*—Patagonia (Santa Cruz).

PHALCOBÆNUS MEGALOPTERUS.

Aquila megaloptera MEYEN, Beitr. 1834, 64, pl. 7.
Milvago megalopterus GOULD & DARW. Zool. Beagle, 1841, 13.—GRAY, List. B. Br. Mus. 1848, 30; Hand-List, i, 1869, 5.—STRICKL. Orn. Syn. i, 1855, 21.—SCL. P. Z. S. 1858, 549 (Ecuador).—SCL. & SALV. P. Z. S. 1868, 569 (Peru); ib. 1869, 155 (Tinta, Peru); Nom. Neotr. 1873, 122.
Polyborus megalopterus CAB. & TSCHUDI, F. Per. 1845, 16, 78.—LAFR. R. Z. 1849, 99.—SCHLEG. Mus. P. B. (Polybori) 1862, 4.
Phalcobœnus megalopterus BONAP. Consp. i, 1850, 13.—GURNEY, Cat. Rapt. Norw. Mus. 1864, 24.—RIDGW. Cat. Falc. Mus. Boston Soc. 1873, 10.
Ibycter megalopterus SHARPE, Cat. Acc. B. M. 1874, 36.
Phalcobœnus montanus d'ORB. Voy. Am. Merid. Ois. 1835, 51, pl. 2; Synop. Av. Mag. Zool. 1838, 2.—BRIDG. P. Z. S. pt. 11, 108; Ann. N. H. xiii, 499.—LAFR. R. Z. 1845, 91.
Milvago montanus DARW. Voy. Beagle, Birds, 1841, 13.—GRAY, Gen. fol. 1844, sp. 5.—PELZ. Verh. z.-b. Ges. Wien, 1862, 135.
Polyborus montanus TSCHUDI, Consp. Wiegm. Arch. 1844, 263; F. P. 1844, 16, 78.—LAFR. R. Z. 1849, 99.
Milvago crassirostris PELZ. Sitz. Akad. Wien, xliv, 1862, 7; Orn. Novara, 1865, 3, pl. 1.

Hab.—Pacific slope in Chile, Bolivia, and Peru.

Descriptions.

Adult.—Feathers of the pileum recurved, narrow, obtuse, and of velvety texture; those of the neck (all round) lanceolate, acute; tibial plumes well developed, fluffy. Colors deep black and pure white, in well-defined, large uniform areas, as follows: Abdomen, anal-region, crissum, flanks, tibiæ, upper tail-coverts, lining of the wings, tips of the outer three or four primaries, of all the secondaries (forming a narrow bar), tips of the tail-feathers (forming a wide band), and bases of the rectrices and remiges, pure white. Other portions carbonaceous-black, becoming smoky-grayish or fuliginous on the throat and chin, but with a faint bluish-green gloss on the nape and back, and very sharply defined posteriorly, with a convex outline against the white of the abdomen, etc. Bill white, dusky olive-plumbeous basally; cere and naked loral and maxillary regions reddish in life; iris —? feet very pale (pale yellow in life?); claws colored like the bill.

Young.—Feathers of the pileum recurved only on the frontlet, and with those on the neck soft velvety and blended. The black replaced with brown (varying from sepia through chocolate to almost a chestnut shade), and the white with ochraceous. Basal portion of the primaries pale ochraceous, finely mottled with dusky; tail-feathers ochraceous for their whole length, edged with sepia, the middle ones nearly uniformly of the latter color.

Remarks.

A specimen in very young plumage (No. 1623, museum of Wesleyan University, Middletown, Conn.) corresponds with the above description, taken from examples in the museum of the Philadelphia Academy, and has the larger wing-coverts as well as the remiges terminated by deltoid spots of ochraceous. In the immature plumage, the light and dark areas are not separated so definitely as in the adult, while the whole plumage is of a totally different texture, being remarkably soft and downy.

Another specimen in the collection of the Wesleyan University (No. 1620), in transition dress, is somewhat peculiarly plumaged. The feathers have the texture of the adult stage, those of the entire pileum being recurved, and those on the neck lanceolate and pointed; but the colors are those of the young stage, with a few scattered feathers of the new molt corresponding with the same in the complete livery. The tail is like that of the young stage, except that there is a sharply-defined terminal band of ochraceous white (narrower than in the adult), preceded by a continuous dusky one, whose basal edge blends gradually into the umber-brown, which forms the general hue of the tail; the medial portion of each feather (comprising nearly the whole of the inner web anterior to the terminal and subterminal bands) is deep ochraceous; the primary-coverts are tipped and irregularly banded with whitish, while the feathers of the flanks are tipped with the same; the upper tail-coverts are scantily spotted with brown.

This specimen exhibits a plumage exactly intermediate between that of the youngest and most adult stages, and was probably acquired after the first molt.

List of specimens in United States National Museum.

Catalogue number.	Corresponding No. of—	Original number.	Sex and age.	Locality.	When collected.	From whom received.	Nature of Specimen.
48804	......	5	♂ ad.	Chili	June, 1864	National Museum of Chili	M.
48805	......	5	♀ ad.	Chili	Sept., 1865	National Museum of Chili	M.

Other specimens examined.

Boston Soc., 2; Mus. Comp. Zool., 1; American Mus., N. Y., 1; Mus. Wesleyan Univ. Middletown, Conn., 7—total 11.

Measurements.

	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.		Locality.
1618, Wesleyan University	15.50	10.00	1.20	3.45	1.50	Adult	Chili?
1615, Wesleyan University	15.60	9.70	1.05	3.50	1.55	..do ...	Do.
1619, Wesleyan University	15.25	9.00	....	3.05	1.65	..do ...	Do.
1616, Wesleyan University	14.60	9.00	1.05	3.15	1.70	..do ...	Do.
1622, Wesleyan University	14.85	9.00	....	3.05	1.60	..do ...	Do.
1620, Wesleyan University	14.60	9.20	0.95	3.05	1.70	Juv...	Do.
1623, Wesleyan University	13.00	8.50	....	3.15	1.45	..do ...	Do.

The sexes compare in measurements as follows:

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. of specimens.
♂....	14.50	8.90	1.00	2.90	1.55	1
♀....	14.75–15.75	9.25–10.00	1.15	3.25	1.70	2

PHALCOBÆNUS ALBOGULARIS.

Polyborus albogularis GOULD, P. Z. S. 1837, 9.
Milvago albogularis GOULD & DARW., Voy. Beag. Birds, 1841, 13, pl. 1 (adult).—GRAY, Gen. B. fol. 1844, sp. 4; Hand List, i, 1869, 5.—STRICKL. Orn. Syn. i, 1855, 22.—SCL. Ibis, 1861, 23.—SCL. & SALV. Nom. Neotr. 1873, 122.
Ibycter albigularis SHARPE, Cat. Acc. B. M. 1874, 37.
Phalcobænus megaloptera BONAP. Consp. i, 1850 13.

Hab.—Patagonia.

Description.

"*Not quite adult* (type).—Above brownish-black, with several rufous-brown feathers on the sides of the neck (the remains of young plumage); feathers of crown slightly recurved; all the quills tipped with white; upper tail-coverts white; tail brown, white at base and at tip; under surface of body entirely white, with one black plume on the throat, and the sides of the body irregularly marked with black, which occupies the most part of the inner and a great deal of the outer web of the feathers; under wing-coverts white; primaries white at immediate base, with broad black bars. Total length, 21 inches; culmen, 1.65; wing, 15.6; tail, 9.3; tarsus, 3.1."—(SHARPE, l. c.)

PHALCOBÆNUS CARUNCULATUS.

Phalcobænus carunculatus DES MURS, R. et. M. Zool. 1853, 154.—GURNEY, Cat. Rapt. Norw. Mus. 1864, 25.
Milvago carunculatus SCL. P. Z. S. 1860, 81; Ibis, 1861, 19, pl. 1.—ORTON, Am. Nat. v, 1871, 624 (Quito Valley)—GRAY, Hand List, i, 1869, 5.—SCL. & SALV. Nom. Neotr. 1873, 122.
Ibycter carunculatus SHARPE, Cat. Acc. B. M. 1874, 38.
Milvago megalopterus SCL. P. Z. S. 1858, 555 (not of Meyen).

Hab.—"Highlands of Ecuador and New Granada."—(SHARPE, l. c.)

"*Adult.*—Above glossy black, the feathers of the head recurved; rump and upper tail-coverts pure white; quills black; both primaries

and secondaries broadly tipped with white; tail black, with a broad terminal band of white; entire breast black, each feather with a large tear-shaped drop of white along the center; under tail-coverts, vent, and thighs pure white, as also are the under wing-coverts and axillaries; bare skin of throat and face wrinkled and deep orange-color, as also the cere; irides hazel. Total length, 19.5 inches, culmen, 2, wing, 15.5, tail, 8.8; tarsus, 3.2."—(SHARPE, l. c.)

Specimens examined, 1, in Mus. Philad. Acad. Nat. Sciences.

PHALCOBÆNUS (SENEX) AUSTRALIS.

Falco australis GM. S. N. i, 1788, 259.—LATH. Ind. Orn. i, 1790, 16; Gen. Hist. i, 1821, 241.—DAUD. Tr. Orn ii, 1800, 56,—SHAW, Zool. vii, 1812, 91.
Senex australis GRAY (J. E.) Jard. & Selby Ill. Orn. n. s. 1839, sub pl. 24.—GURNEY, Cat. Rapt. Norw. Mus. 1864, 20.
Milvago australis GRAY Cat. Acc. B. M. 1848, 30.—STRICKL. Orn. Syn. i, 1855, 21.—ABBOTT, Ibis, 1861, 150.—PELZ. Verh. z.-b. Ges. Wien, 1862, 136.—SCL. & SALV. Nom. Neotr. 1873, 122.
Ibycter australis KAUP; Arch. f. Naturg. xvi, 1850, 41.—SHARPE, Cat. Acc. B. M. 1874, 38.
Polyborus australis BONAP. Consp. i, 1850, 13.—SCHL. Mus. P.-B. Polybori, 1862, 3.
Ætriorchis australis BONAP. Rev. et Mag. Zool. 1854, 11.
Morphnus novæ-zealandiæ CUV. Règ. An. i, 1817, 318.
Falco novæ-zealandiæ TEMM. Pl. Col. i, 1823, pls. 192, 224.—GARN. Ann. Sc. Nat. vii; Isis, 1832, 181.
Polyborus novæ-zealandiæ VIG. Zool. Journ. i, 1824, 336.—LESS. Man. i, 1828, 88.—DARW. Journ. Adv. & Beag. 1839, 66.—BONAP. Consp. i, 1850, 13.
Circaëtus novæ-zealandiæ CUV. Règ. An. i, 1829, 328.
Ætriorchis novæ-zealandiæ KAUP, Class Säug. Vög. 1844, 124.
Circaëtus antarcticus LESS. Tr. 1831, 49.
Polyborus brasiliensis KING, Voy. Beag. i, 1839, 532 (not of Vig. 1824, ex Gm. 1788).
Milvago leucurus DARW. & GOULD, Voy. Beagle, Birds, 1841, 15 (ex Forst.).—GRAY, Hand List, i, 1869, 5.
Milvago pezoporus GOULD, Voy. Beagle, 1841, 13.
Vultur plancus FORST. Descr. Anim. 1844, 321 (not of Lath. 1790).
? *Falco ambustus* GM. S. N. i, 1788, 252.
Vultur ambustus LATH. ind. Orn. i, 1790, 8.
Gypaëtus ambustus DAUD. Tr. ii, 1800, 26.
Spizaëtus ambustus BONN. et VIEILL. Enc. Méth. iii, 1823, 1254.
Polyborus ambustus STRICKL. Orn. Syn. i, 1855, 19.
? *Tawny Vulture* BROWN, Ill. Zool. 1766, pl. 1.
Statenland Eagle LATH. Gen. Synop. i, 1781, 40.

Hab.—Tierra del Fuego (NAT. MUS.).—Falkland Islands (SHARPE).

Descriptions.

Wing, 15.00–16.70; tail, 9.00–11.00; culmen, 1.20; tarsus, 3.00–3.35; middle toe, 2.00.

Adult.—General color dull black, the feathers of the neck and breast marked with medial lanceolate streaks of dull white, these broader on the breast and narrower on the nape; inner side of the tibiæ and adjacent portion of the anal region ochraceous-rufous; lining of the wing mixed with the same. Tail with a terminal band of white, about 1.00 inch wide.

"Bill yellowish, bluish horn-color at base; cere and feet of a bright lemon-yellow; iris dark brown. Total length, 25. inches."—(SHARPE.)

Young.—"Above smoky-brown, clearer on the wings; head and neck blackish, the sides of the latter rufous-ochre, with brownish margins to the feathers; the feathers of the nape and crown with narrow and indistinct fulvous tips; quills brown, primaries clear ochre at the base; upper tail-coverts and tail ochraceous-brown, deeper brown on the external margins; under surface of the body smoky-brown, with rufous-brown

centers to the breast-feathers, not very distinct; bill horn-brown, yellowish at tip of lower mandible; cere and feet slate-color. Total length, 24.5 inches; culmen, 1.25; wing, 16.5; tail, 10.5; tarsus, 3."—(SHARPE.)

Remarks.

According to Gould and Darwin (l. c.), the sexes differ greatly in size and color, the male having the bill *black*, cere *white*, tarsi *gray*, and colors browner, while in the female the bill is *ash-gray*, the cere and feet *dutch-orange.*

The above description of the adult is from the specimen in the National Museum. Sharpe mentions also shaft-streaks of white on outer upper tail-coverts and minute white tips to the feathers of the abdomen, neither of which features exist in the specimen before us, which, however, has a central, broadly-lanceolate spot on each of the primary coverts, white markings at base of inner webs of outer primaries, and narrow, white tips to the same—features not mentioned by Mr. Sharpe.

List of specimens in United States National Museum.

Catalogue number.	Corresponding No. of—	Original No.	Sex and age.	Locality.	When collected.	From whom received.	Nature of specimen.
13928	P. 3	C. 4	—ad.	Tierra del Fuego		United States exploring expedition.	M.

GENUS MILVAGO, SPIX.

Milvago SPIX, Av. Bras. 1824, 12 [type, *Polyborus chimachima* VIEILL].—GURNEY, Cat. Rapt. Nor. Mus. 1864, 26.

GENERIC CHARACTERS.*

General external features.—Bill much as in *Phalcobœnus*, but tomia with the indentations more distinct. Feet slender, the tarsus about one and a half times the middle toe; outer toe just appreciably longer than the inner; claws normal, sharp, but rather short. Tarsus covered with four longitudinal rows of very regular hexagonal scutellæ, the three lower plates of the interno-anterior series twisted to the front, and appearing as a continuation of the plates on the top of the toes.

Pterylosis.—Head normally feathered, but the feathers of the gular region loose-webbed. Remiges, 23. Tracts as in *Ibycter* (*Daptrius*), "but stronger in all its parts, and the spinal tract different, having a remarkably short fork, with its limbs broad and strongly divergent. The posterior portion reaches this fork with its most anterior sparse feathers."—(NITZSCH.) Wing long, the remiges well developed; second to fifth quill longest; first equal to or shorter than the sixth; inner webs of outer four sinuated (three deeply and one slightly). Tail rather long (about two-thirds the wing), very slightly rounded, the feathers rather narrow.

**Osteology.*—What is most probably the skeleton of one of the species of *Milvago* possesses the following characters: Skull most like that of *Ibycter americanus*, but frontal with a very deep median valley anteriorly and suddenly much inflated posteriorly; nostril more regularly circular and more completely rimmed, its tubercle more exposed. Length of skull, 2.30 (1.00); width, 1.15; depth, 1.00. The sternum differs from that of both *Ibycter* and *Polyborus* in possessing a pair of very deep *double* indentations. It measures 1.60, 1.10, 0.90, 0.50. Tibia : tarsus = 2.70 : 2.00.

Relationships.—This genus is of extreme interest, from the fact that it approaches more nearly than any other of the group to the *Falcones*. The general external resemblance to the falconine genus *Hieracidea* is very close indeed; the different emargination of the primaries being the chief distinction.

Species of MILVAGO.

Common characters.—Tail transversely mottled, and more or less distinctly barred with dusky and white (the latter predominating), becoming uniformly dusky terminally in a broad, well-defined zone; tail-coverts white; base of the primaries mottled with whitish.

1. M. CHIMANGO.—Wing, 10.30–11.20; tail, 6.30–8.50; culmen, 0.65–0.80; tarsus, 2.10–2.45; middle toe, 1.25–1.50. Tail grayish-white, becoming pure white basally; its surface finely mottled, the mottling assuming the form of transverse bars toward the base and on the inner webs; terminal zone dusky grayish-brown, not well defined. Primary coverts whitish, barred with dusky or grayish. *Adult:* General color grayish-brown, with a faint fulvous or cinnamon cast, paler, less grayish, and obscurely barred with grayish-white beneath. *Young:* Above dusky brown, the feathers tipped with whitish; beneath transversely mottled with brown and ochraceous, the latter on the tips of the feathers. *Hab.*—Southern South America, from Tierra del Fuego north to latitude 20° south on the Pacfic coast, and to Rio on the Atlantic.

2. M. CHIMACHIMA.—Wing, 10.70–11.80; tail, 7.20–8.50; culmen, 0.75–0.92; tarsus, 1.85–2.20; middle toe, 1.35–2.50. Tail ochraceous-white, crossed by narrow dark bands of coarsely-mottled grayish and dusky—sometimes of nearly uniform dusky—the subterminal zone brownish-black, and well defined. Primary-coverts blackish, unbarred. *Adult:* Head, neck, and entire lower parts immaculate pale ochraceous; upper parts uniform brownish-black, the feathers indistinctly lighter at the tips; primary-coverts broadly tipped with grayish-white. *Young:* Head, neck, and lower parts brownish-black, longitudinally striped with ochraceous-white; upper parts dusky, the secondaries obscurely barred with reddish-ochraceous or dull rusty. *Hab.*—South America generally, south to Paraguay (latitude 20° south), north to Veragua.

MILVAGO CHIMANGO.

Polyborus chimango VIEILL. N. D. v, 1816, 260; Enc. Méth. iii, 1824, 1182.—D'ORB. Voy. Am. Mérid. Ois. 1835, 60; Synop. Av. Mag. Zool. 1838, 3.—DARW. Journ. Resid. 1839, 64.—TSCHUDI, Consp. Av. Wiegm. Archiv, 1844, 262; Fauna Peruana, 1845, 79.—SCHLEG. Mus. P.-B. Polybori, 1862, 6.

Haliaëtus chimango LESS. Tr. 1831, 43.

Caracara chimango D'ORB. Voy. Am. Mérid. Ois. 1835, 60.

Milvago chimango. DARW. Voy. Beag. Birds, 1841, 14.—GRAY, Gen. B. 1844, i, pl. 5 (adult); List, Acc. Br. Mus. 1848, 29; Hand List, i, 1869, 5.—KAUP, Mus. Senck. 1845, 262.—HARTL. Syst. Ind. Azara, 1847, 1.—PEALE, U. S. Expl. Exp. 1848, 61.—BONAP. Consp. i, 1850, 13.—STRICKL. Orn. Synon. i, 1855, 20.—PELZ. Verh. z.-b. Ges. Wien, 1862, 136; Orn. Novara, 1865, 6 (Chili); Orn. Bras. 1871, 392.—GURNEY, Cat. Rapt. Norw. Mus. 1864, 26.—SCL. & SALV. P. Z. S. 1868, 143 (Conchitas, Resp. Argent. resident); Ibis, iv, 1868, 187 (Str. Magellan; Dec.); P. Z. S. 1869, 252 (Lake of Valencia, Venez.); Nom. Neotr. 1873, 122.—HUDSON, P. Z. S. 1872, 534 (Rio Negro, Patagonia).—RIDGW. Pr. Boston Soc. May, 1873, 10.

Ibycter chimango KAUP, Arch. f. Naturg. xvi, 1850, 41.—SHARPE, Cat. Acc. B. M. 1874, 41.

Aquila pezopora MEYEN, Beitr. 1834, 62, pl. 6.—BONAP. Consp. i, 1850 (sub *Milvago*).

Milvago pezoporus DARW. Zool. Beag. Birds, 1841, 13.—BRIDG. P. Z. S. pt. 11, 109; Ann. Nat. Hist. xiii, 499.—STRICKL. Orn. Syn. i, 1855, 20.

Hab.—Southern South America, from Tierra del Fuego northward to 20° south latitude on the Pacific side and to the Tropic of Capricorn on the Atlantic coast.

List of specimens in the United States National Museum.

Catalogue number.	Original number.	Sex and age.	Locality.	When collected.	From whom received.
13930	5	......	Patagonia	....	United States Exploring Expedition.
13931	5	......	Chili	....	Do.
13932	5	......	....do	....	Do.
13933	......	♀ ad.	....do	....	Do.
13934	5	......	....do	....	Do.
20933	......	......	Uruguay	....	Capt. T. J. Page.
20939	97	......	Paraguay	....	Do.
45691	......	♂	Buenos Ayres	....	W. H. Hudson.
48806	6	♂ ad.	Chili (Santiago)	February, 1866	National Museum of Chili.
48807	6	♀ ad.	....do	...... do	Do.
48808	6	♂ juv.	Chili (Valdivia)	....	Do.
49524	1	♂	Buenos Ayres	....	W. H. Hudson.
50939	......	......	Brazil	....	Señor Don F. Albuquerque.
66517	......	......	Buenos Ayres	....	Burmeister.

Other specimens examined.

Mus. Boston Soc., 2; Philad. Acad., 3; Am. Mus., N. Y., 1; other sources, 3—total, 23.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens.
♂	11. 70–11. 80	7. 50–8. 50	0. 75–0. 80	2. 20–2. 30	1. 45	4
♀	10. 90–11. 40	6. 70–7. 10	0. 71–0. 75	2. 10–2. 45	1. 25–1. 50	2

Of three specimens with sex undetermined, the smallest measures as follows: Wing, 10.30; tail, 6.30; culmen, 0.65; tarsus, 2.20; middle toe, 1.36.

MILVAGO CHIMACHIMA.

Polyborus chimachima Vieill. N. D. v. 1816, 259.—D'Orb. Voy. Am. Mer. 1835, 63; Synop. Av. Mag. Zool. 1838, 3.—Schl. Mus. P.-B. Polybori, 1862, 5.

Haliaëtus chimachima Less. Tr. 1831, 43.

Milvago chimachima Gray, Gen. 1841, 2; fol. ed. 1844, sp. 1, pl. 5, fig. 3; List Acc. B. M. 1848, 29; Gen. & Subgen. 1855, 2; Hand List, i, 1869, 5.—Kaup, Mus. Senck. 1845, 262.—Hartl. Syst. Ind. Azara, 1847, 1.—Caban. Schomb. Reis. Guian. iii, 1848, 741.—Bonap. Consp. i, 1850, 12.—Strickl. Orn. Syn. i, 1855, 19.—Pelz. Verh. z.-b. Ges. Wien, 1862, 137; Orn. Nov. 1865, 6 (Brazil); Orn. Bras. 1871, 2, 392.—Gurney, Cat. Rapt. Norw. Mus. 1864, 27.—Salv. P. Z. S. 1870, 214 (Veragua).—Ridgw. Cat. Falcon. Mus. Boston Soc. May, 1873, 10.—Scl. & Salv. Nom. Neotr. 1873, 122.

Ibycter chimachima Kaup, Arch. f. Naturg. xvi, 1850, 41.—Sharpe, Cat. Acc. B. M. 1874, 39.

Falco crotophagus Max. Reis. Bras. i, 1820, 297; ii, 199.

Falco degener Illig. Mus. Berol.—Licht. Verz. Doubl. 1823, 61.

Polyborus degener Vig. Zool. Journ. i, 1824, 336.—Steph. Zool. xiii, 1826, pt. 2, 11.—Less. Man. i, 1831, 88.

Milvago ochrocephalus Spix, Av. Bras. i, 1824, 12, pl. 5.—King, Zool. Journ. iii, 424; Voy. Beag. i, 532.—Gray, Gen. 1844, 2.—Peale, U. S. Expl. Exp. 1848, 61.—Burm. Th. Bras. ii, 1856, 36.

Polyborus ochrocephalus Jard. Ill. Orn. pl. 2.—Swains. Classif. B. i, 1831, 310.

Haliaëtus ochrocephalus Cuv. Règ. An. i, 1829, 327.

Gymnops strigilatus Spix, Av. Bras. i, 1824, 10, pl. 4.

Chimachima Azara, Pax. Par. i, 1802, 50.

Hab.—Tropical America, from the frontier of Paraguay (latitude 28° south) through Brazil and Colombia to Veragua.

List of specimens in the United States National Museum.

Catalogue number.	Correspon'g No. of.	Original number.	Sex and age.	Locality.	When collected.	From whom received.	Nature of specimen.
13871	4	6	......	Brazil............	....	United States Exploring Expedition	S.
16529	......	101	......	....do	....	Capt. T. J. Page	S.
20938	......	42	♂ juv.	Paraguay	March, 1860	......do	M.
20940	......	53	♀ ad.	....do	...do	......do	M.
59048	......	......	......	....do	....	......do	S.
62133	......	2567	♀ ad.	Veragua (Calobre)	....	O. Salvin	S.

Other specimens examined.

Mus. Philad. Acad., 8; Amer. Mus., N. Y., 2; Boston Soc., 4; Mus. Comp. Zool., 2; G. N. Lawrence, 2—total, 24.

Measurements.

Sex.	Wing.	Tail.	Culmen.	Tarsus.	Middle toe.	No. specimens.
♂	10.50–11.80	7.30–8.30	0.75	1.85–2.05	1.35–1.40	3
♀	11.10–11.50	7.75–8.10	0.88–0.92	2.10–2.20	1.50	5

Genus IBYCTER, Vieillot.

a. *Ibycter.*

Ibycter Vieillot, Analyse, 1816, 22 [type, *Falco americanus* Bodd.].—Gurney, Cat. Rapt. Nor. Mus. 1864, 29.
Ibicter Kaup, 1845, (*fide* Gray).

β. *Daptrius.*

Daptrius Vieillot, Analyse, 1816, 22 [type, *D. ater* Vieill.].—Sunder. Disp. Acc. Hemeroharp. 1874, 39.
Gymnops Spix, Av. Bras. i, 1824, 11 [type, *G. fasciatus* Spix=*D. ater*, juv. ?].
Ibycter Auct.—Gurney, Cat. Rapt. Norw. Mus. 1864, 29.—Sharpe, Cat. Acc. 1874, 34.

Osteology (of *I. americanus*).—Skull most like that of *Phalcobænus** (*australis*), but anterior half of the premaxillary relatively much smaller, the posterior half large, broad, and highly arched; nostril nearly circular, imperfectly rimmed; lachrymals narrower, more pointed.† Length of skull, 2.80 (1.15); breadth, 2.45; height, 1.10–1.20. Sternum, 2.20–2.60, 1.35–1.40, 1.15–1.25, 0.50–0.60; posterior margin with two deep indentations, these sometimes connected with a pair of foramina.

General external features.—General form and appearance very similar to that of the buteonine genera *Rostrhamus* and *Cymindis*, the tarsi being unusually short, the remiges greatly developed, and the tail long and broad. Bill much as in *Milvago*, but cere larger, and the irregularities of the tomia less distinct. Nostril circular, imperfectly rimmed, the

* Should we be correct in our supposition that the bones described under the head of *Milvago* as probably of that genus, then we should say that *Ibycter* is very much more like *Milvago* in its cranial characters; but there is a possible suspicion that they may belong to *Ibycter (Daptrius) ater.*

† The palatines are wanting in the only specimens before us.

tubercle not conspicuously exposed. Tarsus scarcely longer than middle toe; outer toe very much longer than the inner; posterior toe about three-fourths as long as the inner. Web well developed. Scutellæ of the tarsus small, irregularly hexagonal, scarcely larger in front; top of toes with a continuous series of transverse scutellæ. Claws normal, long, and sharp.

Pterylosis.—Remiges, 22, unusually developed, but the primaries much larger than the secondaries; fourth or fifth quill longest; first intermediate between eighth and tenth; outer five with inner webs very hallowly sinuated.* Tail long and broad, much rounded. Plumage generally compact and lustrous, but soft and downy on the posterior lower parts. Loral, orbital, and gular regions naked, the skin brightly colored (deep red in life); crop naked, though the space is concealed by the overlying feathers.†

This genus is the most aberrant one of the group, and differs from all its associates in its very aërial and arboreal habits, its very short tarsi, long toes, especially the outer and posterior ones, and in the shallow sinuation of the inner webs of the primaries. Indeed, it resembles so closely, in most of these points, the genus *Rostrhamus*, that without an examination of its skeleton one would hardly hesitate to place it next that genus.‡ The examination of its cranium and the coracoid apparatus, however, shows plainly that it has no real affinity to that genus; but that, on the contrary, it is strictly polyborine.

The two subgenera of *Ibycter* are not very strongly marked, and may be barely defined by the following diagnosis:

a. Size large. Bill slender, the tip much produced; gonys barely convex, nearly horizontal. Bare superciliary region very narrow. *Ibycter.*

β. Size small. Bill thick, the tip only slightly produced; gonys strongly convex, decidedly ascending terminally. Bare superciliary region very wide .... *Daptrius.*

IBYCTER AMERICANUS.

RED-THROATED IBYCTER.

Falco americanus Bodd. Tabl. Pl. Enl. 1783, 25.

Ibycter americanus Gray, Gen. App. 1849, 1; List B. B. M. 1848, 28; Gen. and Subgen. 1855, 2; Hand List, i, 1869, 5.—Strickl. Orn. Syn. i, 1855, 22.—Scl. P. Z. S. 1857, 15; 1858, 449.—Schl. Mus. P.-B. Polybori, 1862, 9.—Pelz. Verh. z.-b. Ges. Wien, 1862, 134; Orn. Bras. 1871, 2, 392.—Scl. & Salv. P. Z. S. 1864, 368 (Panama); ib. 1870, 838 (coast of Honduras).—Gurney, Cat. Rapt. Norw. Mus. 1864, 29.—Lawr. Ann. N. Y. Lyc. ix, 1868, 132 (Costa Rica).—Salv. P. Z. S. 1870, 214 (Veragua).—Ridgw. Cat. Falc. Mus. Bost. Soc. May, 1873, 11.—Scl. & Salv. Nom. Neotr. 1873, 122.—Sharpe, Cat. Acc. B. M. 1874, 35.

Falco aquilinus Gm. S. N. i, 1788, 280.—Temm. Tab. Méth. 1836, 2.

Circaëtus aquilinus Cuv. Règ. An. i, 1817, 317.

Ibycter aquilinus Vig. Zool. Journ. i, 1824.—Steph. Zool. xiii, 1826, pt. 2, 10.—Gray, Gen. B. 2; ed. 2, 2; fol. i, 1844, 9, sp. 1.—Kaup, Mus. Senck. 1845, 262.—Caban. Schomb. Reis. Guian. iii, 1848, 742.—Bonap. Consp. i, 1850, 12.—Cassin, P. A. N. S. Philad. 1860 (Turbo and Truando, N. G.; notes on habits and voice).

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* Very much as in the buteonine genera *Cymindis* and *Rostrhamus*.

† According to Nitzsch, the pterylosis of *I.* (*Daptrius*) *ater* is very similar to that of the *Buteones;* but all the tracts are narrow, the outer branch of the inferior tract broader and quite free, with a strong hook at the end, the dorsal portion of the spinal tract short, the anterior half sparsely feathered, posteriorly densely feathered. The remiges are 22 in number.

‡ Schlegel (Mus. P.-B. Polybori, 1862, p. —) places the species of *Rostrhamus* in *Ibycter!*

Gymnops aquilinus SPIX, Av. Bras. i, 1824, 11.
Polyborus aquilinus LESS. Man. Orn. i, 1828, 88.
Falco formosus LATH. Ind. Orn. i, 1790, 38; Gen. Hist. i, 1821, 260 (*fide* SHARPE, l. c.).—SHAW & NODD. Nat. Misc. xii, pl. 485.—SHAW, Zool. vii, 1812, 159.
Ibycter formosus PELZ. Verh. z.-b. Ges. Wien, 1862, 134; Orn. Bras. 1871, 2, 392.—SCL. & SALV. Nom. Neotr. 1873, 122.
Falco nudicollis DAUD. Traité, ii, 1800, 79, 177.
Milvago nudicollis BURM. Th. Bras. ii, 1856, 37.
Ibycter leucogaster VIEILL. Gal. Ois. 1825, pl. 6.—SWAINS. Classif. ii, 1837, 209.—LESS Traité, 1831, 33.—BONAP. Consp. i, 1850, 12.
Aigle d' Amérique BUFF. Pl. Enl. i, 417.
Red-throated falcon LATH. Synop. i, 1781, 97.

Hab.—Tropical America, north to Guatemala and Honduras, south to Eastern Brazil and Ecuador. Veragua and Para (SHARPE).

Descriptions.

Wing, 13.70–16.60; tail, 9.80–11.70; culmen, 0.90–1.20; tarsus, 2.05–2.60; middle toe, 1.70–2.05.

Adult.—Uniform glossy black, with a dull reflection of bluish-green; feathers on the sides of the neck edged with grayish-white beneath the surface. Abdomen, tibiæ, and crissum immaculate pure white. Bill deep maize-yellow, the base and cere more olivaceous; naked skin of throat, etc., deep red; feet coral-red; claws black. (Colors of fresh specimens.)

Remarks.

Two specimens from "Brazil," in the American Musuem at Central Park, New York, labeled "*Pileatus* MAX," seem to be larger and more brightly-colored than the average of more northern examples; but the differences are very slight. They measure as follows: Wing, 14.70–16.60; tail, 11.70; culmen, 1.08–1.20; tarsus, 2.30–2.60; middle toe, 1.95–2.05. They probably correspond with *I. formosus* PELZ. (*ex* LATH.)—(See Sharpe, l. c. 36, foot-note.)

List of specimens in the United States National Museum.

Catalogue No.	Original No.	Sex and age.	Locality.	When collected.	From whom received.	Nature of specimen.
16805			Panama Railroad		J. McLeannan	
17786			New Granada (Truando)		A. Schott	
17787			New Granada		do	
17788			do		do	
17789			do		do	
41253		♀ ad.	Costa Rica	June 6, 1865	J. Carmiol	
50662		— ad.	Ecuador (Guayaquil)		A. Destruge	M.
53161		— ad.	Costa Rica	May —, 1868	M. L. Calleja	
54020		♂ ad.	Panama		J. McLeannan	
54021		♀ ad.	do		do	
62134	2717	— ad.	Chiriqui		O. Salvin	
64933	564	— ad.	Costa Rica		W. M. Gabb	
64934	609	♂ ad.	do		do	
64935	304	— ad.	do		do	
64936	608	♂ ad.	do		do	
64937	610	♀ ad.	do		do	
67861	115	♂ ad.	Costa Rica (Talamanca)		do	
67878	137	♂ ad.	do		do	

Other specimens examined.

Mus. Philad. Acad., 2; New York, 2, Boston Soc., 3; G. N. Lawrence, 3; R. Ridgway, 1—total, 29.

IBYCTER (DAPTRIUS) ATER.

BAND-TAILED IBYCTER.

Daptrius ater VIEILL. Analy. 1816, 22; Nouv. Dict. xvi, 1819, 387; Gal. Ois. 1825, pl. 5.—VIG. Zool. Journ. i, 1824, 319, 336.—STEPH. Zool. xiii, pt. 2, pl. 32.—LESS. Tr. Orn. 1831, 32.—GRAY, Gen. 1840, 2; ed. 2, 1841, 2; fol. ed. 1844, sp. 2.—KAUP, Ueb. Falk. Mus. Senck. 1845, 262.—CABAN. Schomb. Reis. Guian. iii, 1848, 742.

Ibycter ater SWAINS. Class. i, 1837, 308; ii, 209.—R. SCHOMB. Verz. Fauna Br. Guian. 1840, 742.—GRAY, Gen. 1844, i, 9, pl. 5, f. 1; List B. B. Mus. 1848, 29; Hand List, i, 1869, 5.—BONAP. Consp. i, 1850, 12.—STRICKL. Orn. Syn. i, 1855, 23.—PELZ. Verh. z.-b. Ges. Wien, 1862, 135; Orn. Bras. 1871, 2, 392.—SCHL. Mus. P.-B. Polybori, 1862, 7.—GURNEY. Cat. Rapt. Norw. Mus. 1864, 29; Ibis, Jan. 1875 (description of young).—SCL. & SALV. Nom. Neotr. 1873, 122.—SHARPE, Cat. Acc. B. M. 1874, 35.

Ibycter (*Daptrius*) *ater* RIDGW. Pr. Boston Soc. May, 1873, 11.

Falco aterrimus TEMM. Pl. Col. i, 1823, pls. 37 (*adult*) and 342 (*young*).

Gymnops aterrimus SPIX, Av. Bras. i, 1824, 11.

Circaëtus aterrimus CUV. Règ. An. i, 1828, 328.

Daptrius aterrimus LESS. Man. Orn. i, 1828, 75.

Milvago aterrimus BURM. Th. Bras. ii, 1856, 39.

Daptrius striatus DUMONT, Dict. Sc. Art. Caraçará,—?—VIEILL. Nouv. Dict. H. N. xvi, 387 (*juv.*).

? *Gymnops fasciatus* SPIX, Av. Bras. i, 1824, 10, pl. 4 (*young*).

Circaëtus fasciatus CUV. Règ. An. i, 1828, 338.

Pandion fasciatus GRAY, in Griff. ed. Cuv. Birds i, 1829, 41.

Caracara fasciata LESS. Tr. Orn. 1831, 35.

Ibycter fasciatus GRAY, Gen. B. fol. i, 1844, 9; Hand List, i, 1869, 5.—STRICKL. Orn. Syn. i, 1855, 33.—SHARPE, Cat. Acc. B. M. 1874, 34 (foot-note).

Pandion strigilatus GRAY, in Griff. Cuv. i, 1829, 42.

Hab.—Amazonian district, reaching into Ecuador on the west, British Guiana on the north, and extending along Eastern Brazil as far south as latitude 30° south (SHARPE).

Description.

Wing, 11.75–12.70; tail, 7.80–8.00; culmen, 0.75–0.80; tarsus 1.90–2.00; middle toe, 1.40–145.

Adult.—Uniform glossy black, with a bluish reflection. Tail with a basal (exposed) zone of white. Bill yellow; orbital region and feet red.

Young.—Similar, but black duller, more purplish, and white at base of tail more extended (covering about the basal two-thirds), and crossed with several incomplete black bars or rows of black spots, these decreasing in width and continuity toward the base.

Remarks.

Mr. Gurney's remarks in the Ibis (January, 1875,) on the plumage of the young of this species are important, and we shall therefore quote that portion of them bearing directly on the question of *I. fasciatus*, (Spix). Mr. Gurney says that in the young bird, "the white caudal band extends over the upper two-thirds of the tail, and is crossed by five successive transverse black bars, increasing in breadth from the top downward, the uppermost bar being about a quarter of an inch in depth, and the lowest nearly half an inch, causing the general appearance of the tail to bear a marked resemblance to the tail of the adult of *Ibycter chimachima.* The remainder of the plumage of this specimen is of a paler and more purplish black

than in the adult bird, except some portions of the back and breast, which seem to have been recently molted, and to have thus assumed the ordinary adult coloration. A specimen resembling the above in the markings of the tail is figured in Temminck's 'Planches Coloriées' (pl. 342). It seems probable that *Ibycter fasciatus* Spix is merely the immature bird of *I. ater* in the plumage above described. In a very adult bird from Quito, in the Norwich Museum, the pure white caudal band is varied by two isolated black spots, which I have no doubt are the remains of the black transverse bars which cross this portion of the tail in the young bird. A similar stage of plumage, but with more numerous black spots, is figured in the 'Planches Coloriées' (pl. 37), (p. 95)."

APPENDIX.

The *Ibycter gymnocephalus* of d'Orbigny was based upon specimens seen but not obtained by its describer at Cochabamba, Bolivia. It is probably identical with *I. "formosus"* Pelz. ex Lath. (=*I. americanus*), in which case the following is to be added to the synonomy of *I. americanus*.

Ibycter gymnocephalus D'ORB. Voy. Am. Mérid. 1835, 50; Synop. Av. Mag. Zool. 1838, 2.—STRICKL. Orn. Syn. i, 1855, 24.—GRAY, Gen. App. 1842, 1; Hand List, i, 1869, 5.—SHARPE, Cat. Acc. B. M. 1874, 34 (foot-note).

PLATE 22.

(*Polyborus cheriway.*)

Fig. 1. Figure of adult. [*Greatly reduced.*]

2. Under surface of primaries and terminal portion of lateral half of the tail. [*Reduced to one-fourth.*]
3. Outlines of bill and position of nostril, as viewed laterally and from above. [*Natural size.*]
4. Head and neck, showing extent and character of feathering. [*Reduced to one-fourth.*]
5. Foot, showing proportions and scutellation. [*Reduced to one-fourth.*]

Fig. 1.

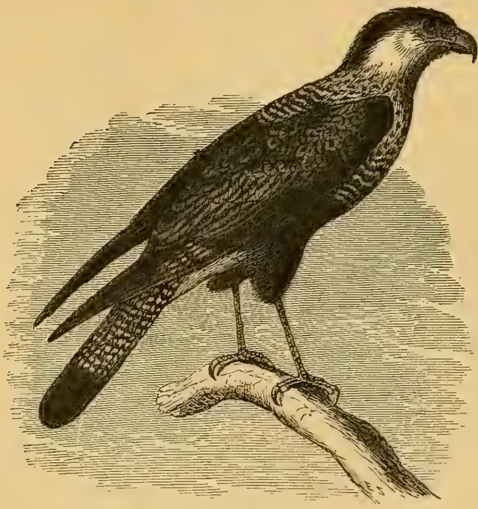
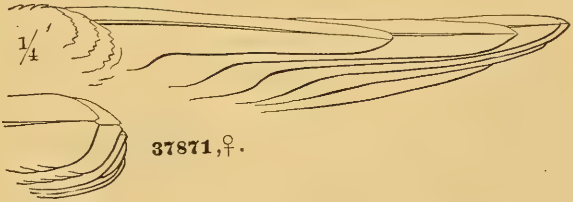


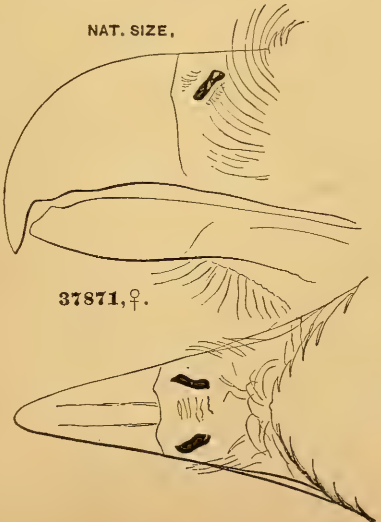
Fig. 2.



37871, ♀.

Fig. 3.

NAT. SIZE.



37871, ♀.

Fig. 4.

¼

37871, ♀.

Fig. 5.

37871, ♀.

¼

PLATE 23.

(*Natural size.*)

Fig. 1. Ibycter americanus; adult.
2. Ibycter (Daptrius) ater; adult.
3. Milvago chimango; adult.

Fig. 1.

Fig. 2.

Fig. 3.

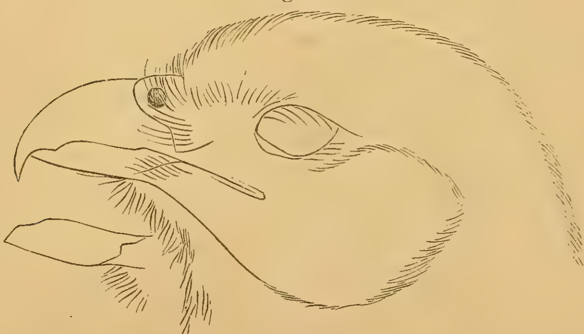


PLATE 24.

(*Natural size.*)

Fig. 1. Supramaxillary, nasals and lachrymal of Phalcobænus (Senex) australis.
2. Coracoid apparatus of Ibycter americanus.
3. Coracoid apparatus of Rostrhamus sociabilis (the Buteonine form most like Ibycter in external form).
4. Sternum of Milvago (chimachima ?).
5. Sternum of Ibycter americanus.
6. Sternum of Polyborus tharus.

Fig. 1.

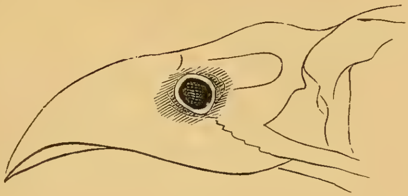


Fig. 2.

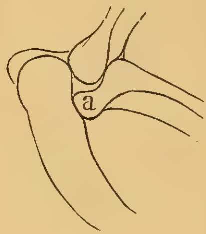


Fig. 3.

Fig. 4.

Fig. 5.

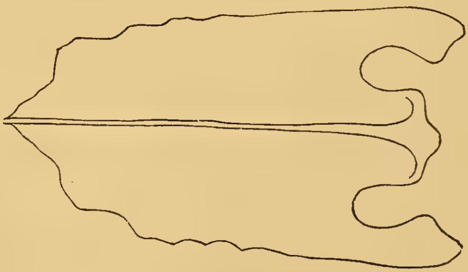


Fig. 6.

PLATE 25.

(Natural size.)

Fig. 1. Superior aspect of skull of Phalcobænus (Senex) australis.
2. Pelvis of Milvago (chimachima ?).
3. Pelvis of Ibycter americanus.
4. Pelvis of Polyborus tharus.

Fig. 1.

Fig. 2.

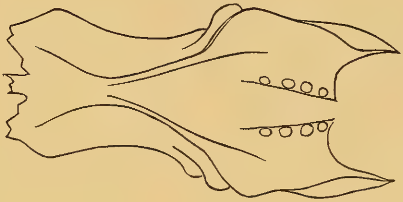


Fig. 3.

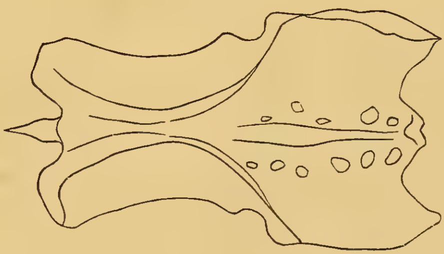


Fig. 4.

PLATE 26.

Fig. 1. Foot of Ibycter americanus. [*Natural size.*]

2. Under surface of primaries of Milvago chimango. [*Reduced one-half.*]

3. Under surface of primaries, and terminal portion of rectrices of one side, of Phalcobænus megalopterus. [*Reduced one-half.*]

Fig, 1.

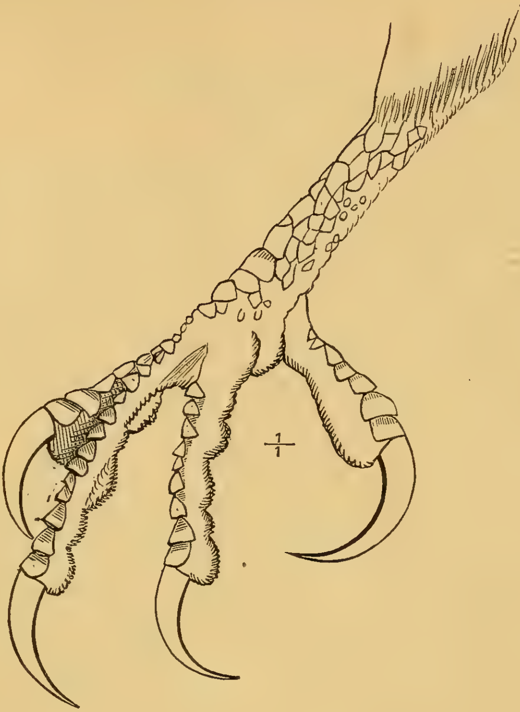


Fig. 2.

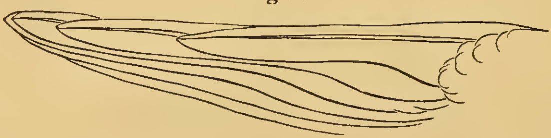


Fig. 3.

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